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The Electric Locomotive.

Some months ago it was pointed out in this journal that the benefits to be derived from the electric operation of suburban trains now hauled by steam locomotives were not to be sought in any material reduction in the expense of train operation. In the comprehensive changes being made by the New York Central authorities at their New York terminal, the electrification of the lines renders other improvements necessary in order that the advantages of the new method of traction may be utilized. In this particular instance the cost of electrification is only about a quarter of the total expense of the changes. The abolition of grade crossings, the reconstruction of stations, and changes in the tracks must also be considered when it is proposed to build up a suburban business by means of the improved service rendered possible by electric motors.

There is another branch of railway operations for which electricity is eminently suited, and as it is not accompanied by conditions rendering necessary so many allied expenses as terminal electrification, it is rather surprising that it has not been developed before this. This feature is the hauling of freight trains on long, heavy grades. This service is the most severe in the country. Not only is it necessary to put on pusher engines, which are expensive in operation, but it is also necessary to allow for very slow speeds on these long grades, which are thus the limiting points on the volume of traffic of the divisions on which they occur. It has long been recognized by electrical engineers making a specialty of railway work, that these grades offered an opportunity for electric operation that should be seized at once. This is not because the electric locomotive will be more economical than the steam locomotive, but because it has other more important advantages. The best explanation of these which has appeared was recently made by Mr. A. H. Armstrong in the columns of the Street Railway Journal, in an article on electricity versus steam for heavy haulage.

Possibly one reason for the long delay in the introduction of electricity on such grades is to be found in the misleading character of the data concerning the cost of operating trains up them with steam locomotives. It is usually asserted that the operating data for the whole division furnish such information, with sufficient accuracy, but that this is not so is proved by a concrete case. One Western road requested the General Electric Co. to furnish an estimate of the cost of operating, electrically, 20 miles of nearly 2 per cent. grade, which it claimed was operated at 34.6 cents per locomotive-mile. Mr. Armstrong's examination of the actual conditions showed that this figure was the operating cost for the entire division. On the grade it actually cost 88.34 cents per locomotive-mile, the increased expense being almost wholly for fuel. The figures are for helper service only, which was of the most severe character; two consolidation locomotives were required for the four or five trains per day running over this section. Several weeks' tests showed that 10.8 lb. of coal per horse-power-hour of useful work were actually burned, and indicator cards showed that the locomotives were working from 0.6 stroke to full stroke, and consequently were burning coal, which cost $4 per ton, very inefficiently. The helper locomotive is thus much more wasteful of fuel than is commonly admitted, and it is also liable to expensive repairs because it must use whatever water is available, and this is often of such poor quality that the boilers are rapidly affected by it.

The substitution of a stationary boiler plant with mechanical stokers and efficient units supplying current to an electric locomotive for the less economical steam locomotive may or may not result in a reduction in the locomotive-mile costs. It is certain, however, that the electric locomotive will accomplish more important results. It can be made more powerful than it is possible to build a steam locomotive which can be operated in tunnels of the present cross-section and on track of present supporting capacity. The greatest advantage, however, is the possibility afforded by the electric locomotive of hauling heavy freight trains up grades and on sharp curves at speeds depending only on the limitations imposed by the condition of the track. Instead of restricting the speed of freight trains to 10 miles per hour or less on the heavy grades, electricity offers the possibility of running at any rate desired. The capacity of the electric locomotive to do work is limited only by the draw-bar pull developed, and inasmuch as this pull is practically independent of the speed on the grade, a congested section will be greatly benefited by the higher speed of the electric locomotive on heavy grades. In fact, where the traffic on a road is limited by the conditions at one or two points alone, it is time to consider electric operation as one of the methods of relieving the situation, along with double-tracking and the reduction of ruling grades.

The Quebec and Blackwell's Island Cantilevers.

The two most remarkable bridge structures now being built are the cantilever bridges, one to span the St. Lawrence River near Quebec, with a single cantilever opening 1,800 ft. long, flanked with two anchor spans each 562.5 ft. long, and the other to span the East River, at New York, at Blackwell's Island, with two cantilever openings, one 1,182 ft. long, and the other 984 ft. in length, with one 630-ft. anchor span between them and with two anchor arms 458 and 469.5 ft. long. Descriptions of these bridges were published in the issues of The Engineering Record for March of this year. A reference to those articles will disclose some remarkable features of design and convey an interesting impression of the capacity of American bridge shops of the present day, sufficing for the manufacture of single compression members 68 ft. long, having a sectional area of 842 sq. in., and weighing 100 tons each, as well as 15-in. eye-bars 76 ft. long, with pins 24 in. in diameter. Such single bridge members are unprecedented, but they are about to become precedents for subsequent designs.

Both the Quebec and the Blackwell's Island structures are pin-connected bridges, whereas the Forth bridge was all riveted. These two bridge structures are worthy of special comment in a number of other respects. In the first place it is a well-known fact that an eminent American engineer, closely familiar with the most advanced suspension bridge designs, made a competitive plan of that type for Quebec, but found it less economical than the cantilever structure. This decision in favor of the latter bears directly upon the relative economy of the two types of bridges for long-span purposes. It is clear that there is some maximum length of opening for which the cantilever must yield to the suspension bridge for adoption on the score of economy. The competitive computations made prior to the final selection of plans for the Quebec bridge appear to indicate that that maximum limit is above 1,800 ft. for the loads employed in that case. It has frequently been supposed that the stiffened suspension bridge would find economical adoption for spans about 2,000 ft. in length. Manifestly there have been few complete designs made to test this question by actual weights of structures, but fortunately the instance under consideration yields data up to a span length of 1,800 ft. Actual designs with complete computations of weights are still required finally to determine for specified loads at what limit the cantilever ceases to be economical, and above which the stiffened suspension system must be adopted.

Again, it has generally been supposed that the stiffened suspension bridge is the only suitably graceful structure for spanning the East River, but the Blackwell's Island cantilever may reasonably be expected sufficiently to illuminate this problem to make it clear whether or not suspension bridges must hereafter be built for Greater New York on esthetic grounds. While even that bridge may not fully possess the same gracefulness or other esthetic qualities of a well-proportioned suspension bridge, it is believed that the advantages of this class disclosed by the final plans now being executed will be sufficient to indicate its adaptability to long spans in locations where esthetic requirements are most exacting. A reference to the published plans will show that the outlines of the entire structure are highly pleasing, with rational accentuations in the design showing the changes from the parts of the structure of one kind to those of another, thus giving direct expression to structural truth.

Another unusual condition in both these structures is the system of heavy loading to be accommodated. The Quebec bridge has a single deck on which are to be carried two railroad tracks, two highways and two electric car tracks, with provision for sidewalk brackets on the outside of the trusses, should they be needed. The width between the centres of the trusses on this floor platform is 67 ft. The loading to be carried by the Blackwell's Island bridge is extraordinarily heavy, consisting of four lines of street car tracks and a 36-ft. roadway on the lower deck and two railroad lines with two 11-ft. promenades on the upper deck. The Forth cantilever was designed to carry only two railroad tracks. It is literally true that no bridges of nearly the same length of spans have heretofore been constructed for such heavy loads as those for which provision has been made in these two cases.

The trusses on both these bridges are placed in vertical planes with no attempt to reach any additional small economy in the transverse and upper lateral bracing which would result from inclining the trusses, as was done in the Forth cantilever, but at the disadvantage of some additional cost in the details and in the added metal in the trusses. It is probable, also, that a more satisfactory appearance will be secured by the vertical truss planes.

The distance between the centres of trusses transversely, affects largely the lateral stability of the structure. In order to secure about the same lateral stiffness found in simply supported non-continuous trusses with a width between truss centres equal to one-eighteenth of the span, the trusses in a cantilever opening should be separated about one-twenty-seventh of the span. The provisions made for the various lines of traffic on the two decks of the Blackwell's Island bridge, made necessary a width of 60 ft. between truss centres, which is but one-twentieth of the span. In the Quebec bridge, on the other hand, the distance between centres of trusses was fixed at 67 ft., which is very closely one-twenty-seventh of the span length, or just about the distance required as a proper minimum.

Up to this point the two bridges present about the same general features of design; but in one respect they are radically different. The Quebec plan shows a suspended span 675 ft. long between the two cantilever arms, whereas the Blackwell's Island cantilever openings have no suspended spans whatever, the ends of the cantilever brackets meeting at mid-span with suitable details to insure a common deflection at that point. A good rule for a cantilever structure is to make the suspended plan, when used, but little, if any, less than one-half of the cantilever opening. In the Quebec case, however, that length has been taken at three-eighths of the total opening. It is probably not economical to omit the suspended span, although the omission of any additional metal required for the erection stresses in the suspended span may largely neutralize that economy. The presence of the suspended span has been so generally accepted as essential that the erection of a great cantilever structure without such a span is a most interesting event. Manifestly deflections and temperature movements at the meeting of the ends of the cantilever spans may easily be accommodated without a suspended span, and when the beaten paths of precedent are displaced by new but well considered procedures in a bridge of such magnitude, the results cannot fail to be interesting. This latter observation is as true in connection with the employment of nickel steel eye-bars as of any other features of design.

Theatre Construction.

The construction and equipment of theatres is a subject that very properly interests a large part of the public. Probably no class of building in which large numbers of prople assemble is exposed to such opportunities for using dangerous structural features. In order to afford an unobstructed view of the stage from all parts of the auditorium it is necessary to avoid the use of columns, and this necessitates unusual details in the steelwork, which are not always as well considered as they should be. The various mechanical devices needed in a modern theatre also lead to peculiar requirements of a mechanical nature, and in their installation it is necessary to consider their effect on the safety of the building. This is particularly the case because a theatre is a peculiar property from an investment standpoint. It is used by the income-producing visitors but a few hours a day, and even then but a small part of the structure is visited by them. Consequently there is a natural tendency to save all possible expense in construction and to hide crudities in the framework of the parts seen by the public by ornate decorations. The average theatre owner knows very well that any suspicion that his building is unsafe, either structurally or from a fire-resisting point of view, will have a marked effect on his business; but nevertheless the incentive to be economical in such buildings is so pronounced that it is necessary for the public welfare to have every possible safeguard put about their use by the public.

The official inspection of such buildings is generally more or less of a farce. The building laws of most cities do not require really good details for this class of structure, and the safety of the public against the most serious form of disaster, destruction by fire, depends very largely on the position taken by fire insurance interests. Fortunately the insurance engineers are alive to their responsibilities, and this week the National Fire Protection Association held an important discussion on the subject, introduced by a report of its committee on theatre construction and equipment. An examination of this report shows that the resistance of such a building to fire is so closely related to its structural safety that the two can be considered at the same time by the architect, without increasing his work in any appreciable degree. In fact, the only section of the recommendations of the committee which are not of a structural nature relate to the provision of courts about the building, affording egress to everybody in the structure in case of fire.

It is not surprising that the requirements for fire-resisting construction in a theatre are practically the same as those for structural reliability, when it is considered that the uses to be made of the building call for unusually strong construction. The proscenium wall and arch, the mechanical features of the stage and the provision of dressing rooms in such a place that they can be readily reached without having the actors in the way of the stage hands, all call for the same kind of construction that the engineers of the insurance interests consider necessary. Consequently, it is to be hoped, on the score of the general safety of the public, that the insurance underwriters will make their rates on buildings of this class such that no owner can afford to put up any other than a safe structure. It is fairly certain that the building laws and the regulations of the police and fire departments will not be properly inforced, and about the only protection against skin building which the public has to-day is the backbone of the insurance interests in demanding good construction and equipment before low rates are granted. The National Fire Protection Association is doing good work in insisting on such construction, and deserves the support of the public in the position it is taking.

The Purchase of the Winthrop Water-Works.

The purchase of the water works supplying the town of Winthrop, Mass., by the authorities of that city, was effected with an ease and expedition that deserve comment. The plant was built by the Revere Water Co. in 1884, under a contract providing that it might be purchased by the town at any time within twenty years at a price to be fixed by three appraisers. The original sources of supply became unsatisfactory some time ago, and since 1899 the water has been purchased by the company from the Metropolitan works. The portion of the company's property in Revere was recently bought by the authorities of that place, and the sale of the Winthrop property was a natural consequence. Instead of going to the expense of three appraisers and the usual legal luminaries, the town and the company made the following agreement: "The town may select any competent and disinterested engineer, approved by the company as such, who shall tell the committee, upon due investigation, the price which in his judgment the town can afford to pay, and to sell the property at that price." Mr. George A. Kimball was selected as the engineer for this work, and his report has been adopted, the money for the purchase being voted in March.

Where both parties to such an agreement leave the appraisal of such a valuable property to a single individual, the process by which he determines the proper price at which to make the sale is of special interest. Under such conditions, the engineer works under a heavy incentive to be absolutely fair to both parties, while in most appraisal cases he does not have any obligations except to one party. In this particular case, it was found that the company had spent over half a million dollars on the construction of its plant for supplying Winthrop, Revere and Saugus, but a considerable portion of this expenditure was for the plant that had been abandoned. Accordingly, in fixing the going value of the company's property very little attention was paid to its cost. The income from Winthrop was carefully determined and found to be a little over $40,000, of which ten per cent. was paid by the town. The company's capital stock was $125,000 and the outstanding bonds amounted to $200,000; in recent years $25,000 dividends had been paid annually, and $10,000 interest on the bonds had been paid from the outset. The physical plant which could be used in Winthrop was carefully determined by actual survey and its present value determined at about $102,000. The water rates were examined critically and found to be about ten per cent. too high for the service furnished and its cost. The maintenance expenses, exclusive of allowance for depreciation and interest, were put at $16,500. Careful consideration was paid to the fact that the company had an assured supply of good water, a large number of water takers and was free under the Metropolitan Water Act from any competition by public water works. Consequently, the company was regarded as a live, going concern, yielding a good income, which must be bought out on the basis of its present value. No allowance was made for future increase in earnings as it was problematical, and if it should occur the town and not the company was apparently entitled to profit by it. Taking all these conditions into consideration, Mr. Kimball decided that $250,000 was the sum that the town ought to pay for the works.

It is decidedly gratifying to notice that an engineer of Mr. Kimball's standing has advised that the property of a successful public-service corporation was worth more than the mere present value of so much of its tangible plant as could be used in the construction of new works. This company spent over half a million dollars in building works for supplying water to three small towns, and its capital stock and bonded indebtedness represented only about half of this expenditure. Its rates were not high for the vicinity and its customers were satisfied with the service. In other words, it was a well-established business. It was merely ordinary justness to pay for such a business more than the value of a portion of its plant. As a matter of fact, the town is actually a gainer by the purchase, for a reason stated as follows in the engineer's report: "If the town purchase the works at the price herein named, the sum paid the company, together with the expenditures recommended for improvments, a total of $295,000, can be paid in full from the earnings of the works in twenty-five years. The water company is willing to accept 3½ per cent. bonds in payment." In other words, the company will be paid a fair sum for its property as a going business, the water rates will be reduced ten per cent., necessary improvements will be made in the plant, and the whole will be paid for by bonds which will be paid off by the earnings of the works, if properly managed. Such a mutually satisfactory result is a distinctly good engineering achievement.

The M. I. T.—Harvard Alliance.

There are few topics under discussion at present of more general interest than the proposed alliance of the Massachusetts Institute of Technology and Harvard University, and for this reason the summary of the views on the subject of the Institute's faculty, printed elsewhere in this issue, is of much value. It is these men who deserve a large measure of the credit for the college's grand achievements, although, of course, the trustees and the president, by their business and executive ability, are primarily responsible. On their selection of the members of the faculty and their administration of its most intimate affairs has hinged the success of the Institute. The faculty, however, is the teaching body which determines very largely the standing of a school in the public estimation, and in this proposed alliance its opinions deserve careful consideration.

In reading the voluminous majority and minority reports of the faculty on this subject, a serious defect of engineering education as carried out today is immediately apparent. It is the frequent reference to past traditions instead of future possibilities. Wherever technical education is stagnant it is because of the inbreeding of alumni into the faculty, the lack of push on their part, or a scarcity of funds. In any case, there is a lot of talk about alumni, what they ought to do and what they will think about any new departure. As a matter of fact, outside of the graduates of Harvard University, and the National military and naval academies, alumni are broken reeds, so far as reliance can be placed on them for good, earnest, continued help.

It is only natural that this should be so. A young man gives up four years to pursuing a course of study at some school, where he pays tuition fees. These do not cover more than one-half to two-thirds of the cost of the instruction given him, but they are all he is asked to pay. He buys so much tuition and when he gets it he leaves the place, just as a man buys a pair of shoes and walks away with them. A tradesman refers to satisfied consumers with pride, but he does not depend very much on their help in carrying on his business. He keeps his stock fresh and well advertised. In the same way a school cannot safely rely very much on its alumni. They are of value as satisfied customers, to furnish references when requested, but that is about all. They are of no more value to a school than are former customers to a shoe store, although the noise they make would sometimes lead the observer to consider them superior to the trustees and faculty.

In any such matter as this proposed alliance, it is difficult to appreciate how any other considerations should carry weight than those that affect the character of the instruction that the alliance would furnish future students. They are the people who will benefit or suffer. The alumni bought their instruction and are out of the way. Except as a rather noisy group of gallery gods who cheer or jeer the real actors without materially helping them, they really do not count. They probably retard development by increasing the constant deplorable tendency of educators to look backward on their completed work instead of looking about them for means to turn out better work in the future.

Notes and Comments.

One of the Motor Car Types in use on foreign light railways has a gasoline engine driving a dynamo which furnishes current to the usual outfit of motors on the trucks. A car of this type has recently been put in service on the St. Joseph Valley Traction Co.'s line between La Grange and Middleboro, Ind. It has a 70-h.p. Walrath engine driving a 50-kw., 250-volt Sprague generator. A 120-cell storage battery is provided for heavy loads in accelerating. The equipment weighs about 5 tons and occupies about a third of the floor space of the car, which is 34 ft. long over end sills. On the trial trips a speed of 26 miles an hour was easily made, hauling the private car of the Chicago Heights Terminal R. R. with about 40 passengers.

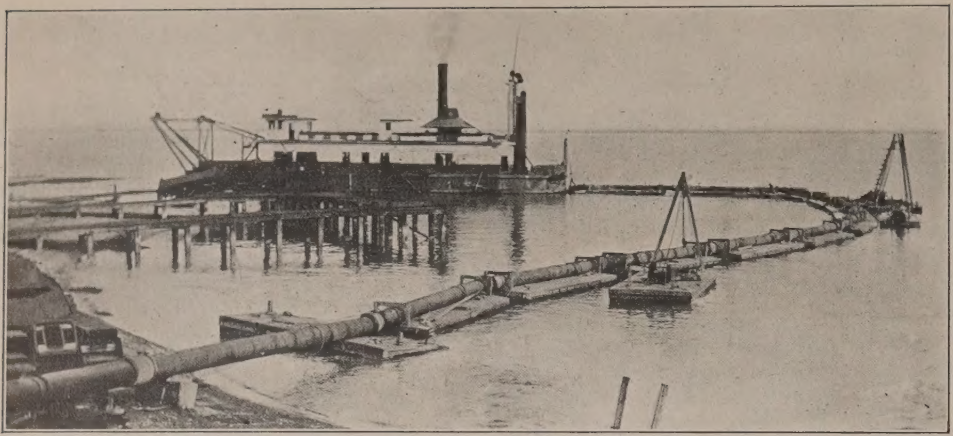
A Handsome Arch Bridge at Kinclaven, illustrated in "Engineering" of May 12, deserves special attention for the pleasing effect due to the unusual shape of the arches. There are six of these, each of 61½ ft. span and 13½ ft. rise, consisting of two ellipses intersecting obliquely at the crown. This avoids the flat effect of a true elliptic arch of these dimensions, by affording a slightly Gothic profile. Another feature of the design that merits attention is a five-course corbelling above the arches along the entire length of the bridge. This gives an additional width of 1 ft. on each side of the roadway, furnishes an attractive relief to the flat face of the structure, and saves considerable expensive pier and arch masonry. The bridge is built of gravel concrete faced with stone.

The Steam-Turbine Section of the Glasgow, Scotland, lighting station, which is now approaching completion, will contain six 3,000-kw. Willans & Robinson turbines direct-coupled to Dick-Kerr alternators. The turbines will be supplied with steam at 190 lb. superheated to 550 deg. at the stop valve. Each unit has an independent surface condenser required to "maintain continuously a vacuum equal to 2½ in. below the barometer." The circulating water will be taken from a canal 40 ft. above the level of the condensers through a suction pipe 700 ft. long. After passing through the electric-driven centrifugal circulating pump and the condenser it is discharged into the canal again. The condensed water is also delivered 40 ft. above the floor level by a pump driven from the end of the air-pump crank-shaft. The steam is furnished by Babcock & Wilcox boilers with superheaters and chain grates. Each has 100 ft. grate area and 6,182 sq. ft. of heating surface.

Revised Estimates, particularly where they call for greater expenditures than preliminary estimates, are decidedly unpleasant papers for an engineer to prepare. Sometimes it is claimed that such increased estimates invalidate an assessment for public work; a claim of this sort was raised in Denver v. Kennedy, 80 Pac. Rep. 122, but the Colorado Supreme Court overrules it as follows: "After steps had been taken by a city to construct a viaduct, it was found that the original estimate of the expense was not sufficient to complete the work. Thereupon an increased estimate was made by the city engineer, and notice was again given the property owners in the assessment district, as required by the charter. All parties were thus given a full opportunity to be heard under the second notice on any question which they might have raised if that notice had been the first one. Held, that the second estimate was, in effect, an original estimate, and did not violate a provision of the charter prohibiting an increase in the cost of the construction of an improvement above the original estimate."

The Copper Sulphate Cure for certain bad conditions in a water supply has suffered so much at the hands of over-zealous advocates that it is desirable to point out the very modest claims made for it by Dr. George T. Moore, who first suggested it. In an address reported in "Science" he recently said: "Over and over again is the statement made (in the published accounts by the Department of Agriculture) that it was not designed or intended to replace efficient methods now in use. The only claim made for it has been that it furnishes in one case a remedy for a condition previously considered hopeless, and in another case, as an emergency method, owing to the failure of means already in use, it offers the best way of quickly, thoroughly and cheaply sterilizing a large body of water that has been devised." This statement is a conservative opinion in keeping with the views of many specialists. Just what the future use of copper sulphate will be cannot be stated now, but there is some reason for believing that the objection to its use will very largely disappear, just as the objection to sulphate of alumina has practically vanished.

An Extraordinary Boiler has been developed by the Nuremberg Machine Co. to burn peat at the peat briquetting works of Sachsenberg Bros. at Rosslau-on-Elbe. The material is dredged from below water and delivered into large basins. From these it is run through filter presses until it contains 65 to 70 per cent. of water, when it is dried and pressed into briquettes like brown coal. Steam is furnished for the engines of the plant by boilers using the wet peat for fuel. The boiler first evaporates the water of the peat in order to dry the latter, and then parts of the dried material are used to raise the steam to high working pressures. The remainder of the peat is compressed. Mr. M. Gercke,, engineer of the Nuremberg Co., recently made the following statement concerning the power resources of a peat bog: "A peat-utilizing plant, consisting of a 3,000-h.-p. central electric station and works capable of turning out about 200 tons of briquettes daily returns nearly half of the energy in the peat in the form of electric current and briquettes." This statement is much stronger than any made by Mr. Edward Atkinson in his arguments for "mud fuel," but it is a good indication of the high opinion held by many German engineers of the value of this material.



Dredge Used in the Manila Harbor Improvements.

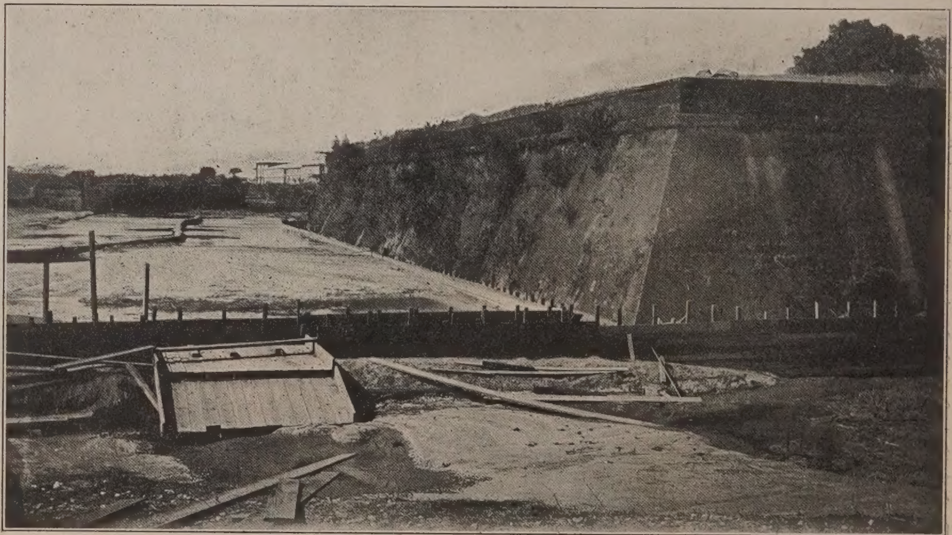
THE MANILA HARBOR IMPROVEMENTS.

The dredging work and breakwater construction in connection with the improvement of Manila Harbor are being rapidly carried on, and it is estimated that they will be completed within the next six months. The general project consists of a breakwater, 8,635 ft. long, and a detached outer breakwater, 2,785 ft. long, protecting a harbor of about 380 acres, divided into a large outer basin, having a uniform depth of 30 ft. below low-water line, and an inner basin, 18 ft. deep. The Spanish Government began the improvements about 1892 and considerable work was done by it, which has been utilized in the project adopted by the American engineers. A contract for the completion of the undertaking was awarded to the Atlantic, Gulf & Pacific Co. in 1901, and construction was begun in February, 1902.

The shore breakwater is a rubble stone embankment to low-water mark, with a slope of 1 on 2 to 1 on 3 on the exposed side and 1 on 1 on the harbor side. A masonry superstructure, 11 ft. high above low-water mark and 10 ft. wide is built on top of the rubble embankment and the whole breakwater is protected by rip-rap to 6 ft. above low-water mark on the exposed side. The outer breakwater has a natural slope of rock as deposited to within 12 ft. of low-water on the exposed side. Above this elevation on that side the slope will be 1 on 2 to the top of the breakwater, 8 ft. above low-water, while on the harbor side the slope will be 1 on 1 to the same height. This breakwater is composed of large stone, many of the single pieces weighing over 10 tons; above low-water the material is carefully laid to slope.

The dredging is being done with a large hydraulic dredge of the rotary cutter type, which was built in this country and shipped in sections to the Philippines. The steel hull was assembled and the machinery installed at the shipyard which the company established near the site of the work. Native labor was employed almost exclusively in assembling the sections of the dredge, which was launched in November, 1902, and began operations Jan. 30, 1903. Its equipment consists of a 1,000 h. p. high-speed triple-expansion engine, with a surface condenser, two engines operating the excavating and swinging devices, an engine driving the machinery of the electric light plant and the machine shop and feed and fire pumps. Steam is furnished by four large water-tube marine boilers. The entire operation of the dredge is controlled by one man in the pilot house. The dredge has excavated and discharged an average of 20,000 cu. yd. of harbor mud a day since it has been in operation. The timber bulkhead behind which nearly 5,000,000 cu. yd. of the excavated material has been placed is 5,095 ft. long, and the material has been discharged so as to reclaim about 190 acres. On this reclaimed land it is proposed to build deep water docks and bonded warehouses, which may be approached at any stage of the tide by vessels drawing as much as 30 ft. of water. About 1,500,000 cu. yd. of excavated material remained to be disposed of after the reclaimed area had been completed. Nearly 1,000,000 cu. yd. of this surplus is being discharged into the moat which separates the walls of old Manila from the site of the newer city. This moat receives the drainage of the walled portion of the city, so a timber bulkhead has been constructed 3 ft. from the walls, forming an open ditch in which the drainage flow will be carried until the sewerage system, which was recently commenced, is completed. This ditch also carries the water discharged from the dredge with the filling material and will be filled when the sewerage system is installed. The material remaining after the moat has been filled will probably be used in water-front improvements.

The quarry which has been opened by the contractor near the entrance of the bay has been worked almost entirely by native laborers. The cliff in which the quarry is located rises abruptly from the edge of the water in an arm of the bay and the quarry is worked with a number of stiff-leg derricks and a 1,500-ft. span cableway which loads the stone on deck scows. It has been possible to obtain all the native labor required on any part of the harbor work, but the experience has been that good American foremen are necessary to secure the best results.



Timber Drainage Ditches in Moat which is Being Filled with Dredged Material.

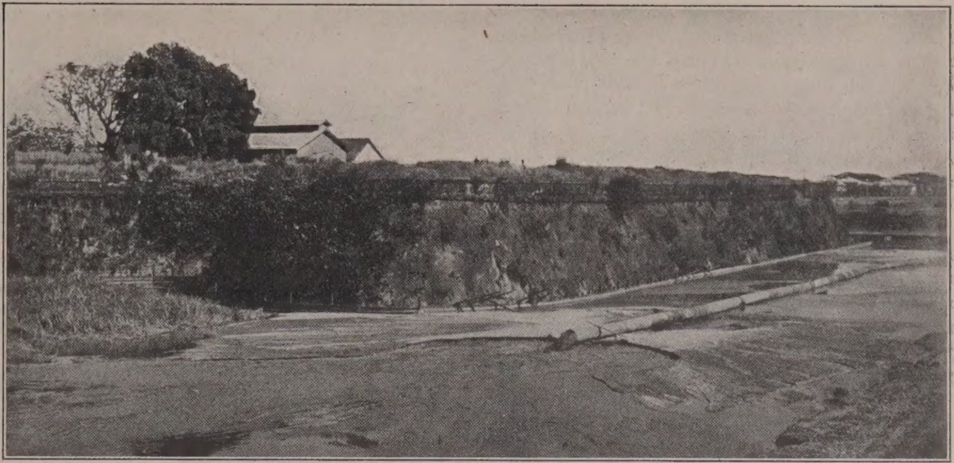
The estimated cost of the improvement was $2,250,000, but the work will require an expenditure considerably in excess of that amount. In the construction of the shore breakwater 250,000 tons of rip-rap rock, 10,000 tons of rubble masonry and 5,000 cu. yd. of concrete coping have been used. Approximately 300,000 tons of rock have been placed along the bulkhead, and it is estimated that the rock required in the detached breakwater will somewhat exceed the original estimate of 90,000 tons. There is considerable dredging yet to be done in the harbor and the outer breakwater has only been built to the low-water line.

A number of breaks have occurred in the bulkhead surrounding the reclaimed area which have necessitated the strengthening of that structure on several occasions at government expense. Other difficulties have been encountered requiring increased expenditure, among them being the softness of the soil excavated from the harbor bottom. This soil is a stiff mud, mixed with shells in some cases, and numerous borings have shown that the bottom of the harbor is of the same material to a depth of 117 ft., the maximum depth of boring recorded. The foundations of the walls of the breakwater have sunk into the mud at least 24 ft., but Major C. McD. Townsend, Corps of Engineers, U. S. A., who has been in immediate charge of the improvement for the United States Government, is of the opinion that the settlement has largely ceased. The reclaimed dock area is drying out quite rapidly, still Major Townsend does not believe that it will ever be safe to build large structures on the reclaimed land unless they are provided with pile foundations.

Purification of Gas Works Liquors.

The waste water from gas works causes offensive conditions in so many instances that its purification is often necessary. The subject was recently discussed in a paper before the Ohio Gas Light Association by Mr. James S. McIlhenny, of Washington, D. C., who stated that the heavy tar may be separated in the ordinary form of settling basin fitted with baffle plates, while those oils which are lighter than water may be removed from the surface of the basins with skimmers. The oils which are of the same specific gravity as the water and those which are so intimately brought in contact with the water during the process of manufacture as to form an emulsion cannot be separated by any gravity or friction process. Although they form a small percentage of the waste, they must be removed before any process of purification is effectual.

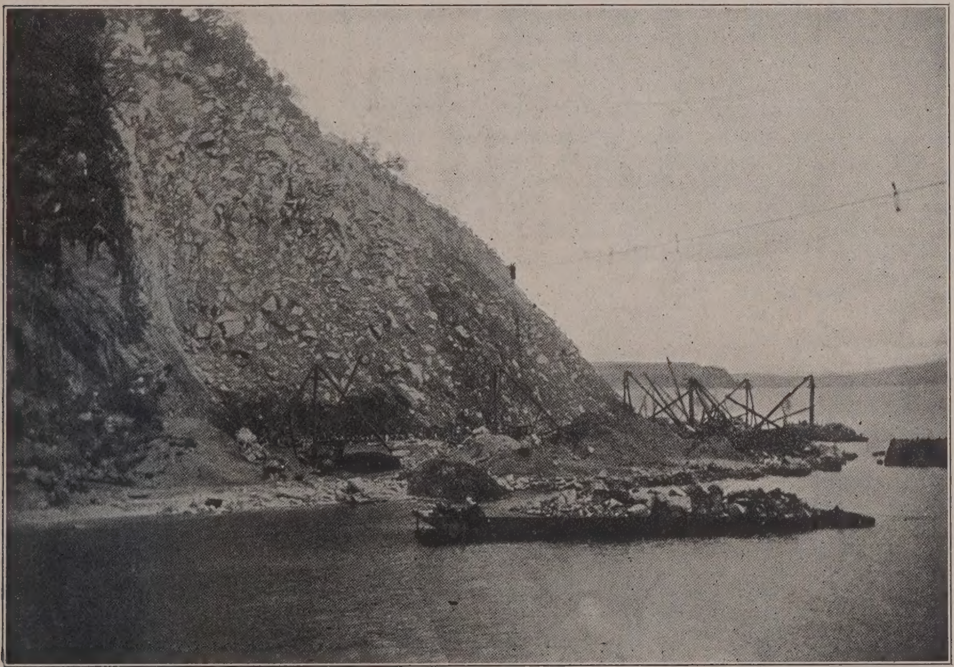
Unsuccessful attempts to remove these oils by various processes led Mr. McIlhenny to experiment with different forms and arrangements of filters using several kinds of filtering materials. Coke breeze was the only material that proved of any practical value. It satisfactorily removed all traces of tar and oil, leaving the water quite clear, and as it is at hand or easily procured by any gas works its use is entirely feasible.



End of One of the Discharge Pipes used in Filling the Manila Moats.

Two rectangular concrete filters, 30 ft. long, 9 ft. 6 in. wide and 4 ft. 10 in. deep, were built and operated in connection with settling basins containing baffles for the removal of heavy tar and light oil. Each filter is connected with the settling basins by a 12-in. pipe controlled by a valve. The outlet is at the opposite end from and 8 in. lower than the inlet and each filter can be operated independently. A water-tight wooden division wall extends the width of the filter, from the top to within 2 in. of the bottom, at the outlet end. The water passes down through the filtering material and under the division wall to reach the outlet opening, which is about 3 ft. above the bottom. The bottom is sloped to a drain pipe at the outlet end, the pipe being controlled by a stop cock. The bottom of the filter is covered with wooden grates made of ¾ x 1½-in. slats, spaced 1 in. apart and fastened to 1½-in. battens. These grates are made in sections 3 ft. wide, extending the width of the filter, so they may be easily handled when the filter is being cleaned. The battens are arranged to be in a continuous line when all the grates are in position, leaving about 1½ in. of the total superficial area of the filter under the grate surface for the free passage of water.

Over the gratings is evenly placed a 6-in. layer of coke in which the larger pieces are either broken up or thrown out. On top of this 6-in. layer of larger coke is placed three 12-in. layers of ordinary run-of-the-yard coke breeze, making 42 in. of filtering material, the depth found to produce the best results. The breeze should be carefully, but not too firmly, placed in position, Mr. McIlhenny says, and mixing and placing it in layers is imperative to uniform filtration.



Quarry from which Stone for the Breakwaters at Manila is Obtained.

The waste from the separator is admitted to the filter after the filtering material is in place, the oils that will float rising to the surface as the water begins to be discharged at the outlet. The tar or oil held as an emulsion penetrates into and is absorbed by the coke breeze. This penetration and absorption have been found to continue gradually downward until the oily substance reaches within 6 in. of the bottom before any oil is evident at the outlet. A soft, tarry substance, 1 to 1½ in. deep, consisting of the heavier matter which had escaped the baffle-plate separators, was found to be deposited over the entire top surface of the coke when the filter was cleaned. A sample of the breeze from near the bottom of the filter, when shaken up with water at 160° Fahr., immediately showed a surface deposit of very light oil which covered a large area when thrown on cold water. A sample of the sediment from the top of the filter, when shaken up with hot water and allowed to settle, showed a large quantity of light oil on the surface of the water.

The coke in the filters had to be renewed every 4 to 8 weeks, depending on the rate of flow and the character of the waste to be filtered. Good results have been obtained with a rate as high as 10 gal. per square foot per hour, the temperature at the inlet being 128° Fahr. and at the outlet 109°. The cost of changing the filtering materials is slight, and Mr. McIlhenny states that as the coke is thoroughly saturated with light hydrocarbon oils, its value as boiler furnace fuel is sufficiently increased to cover the cost of renewal.

A small filter used without the aid of a separator produced equally satisfactory results; still, Mr. McIlhenny does not recommend this method, since the filtering material has to be renewed too frequently and the tars can only be handled in connection with the coke breeze.

The Design of Reinforced Concrete Beams.—I.

By George H. Blakeley, M. Am. Soc. C. E.

Probably the most marked recent development in building construction in this country is the increasing use of reinforced concrete. At first employed in a limited way for floor slabs or filling between the floor framework of buildings, its use has been rapidly extended until the supporting girders, columns and even entire buildings are made of this type of construction. Applications of this system in new directions are constantly being made. Many such extended uses of the construction are at best experimental, having yet to stand the test of service and to receive the sanction of conservative constructors; but for floor slabs or filling between the beams of floors for spans of moderate length, or even for long spans, the system when properly designed and executed has merits worthy of consideration. The construction has been advanced in this country largely by the exploitation of special or patented forms of steel bars for the reinforcement forming the basis of several so-called systems. The tables and formulas for the calculation of strength given in the catalogues and literature of these systems upon comparison reveal a lack of agreement which is disconcerting and misleading to those who are not specialists in concrete construction, yet who desire to specify a conservative construction or intelligently criticise a design submitted for approval. The purpose of this article is to present some formulas for transverse strength of the simple case of reinforced concrete slabs for floor construction which shall be in accord with rational theory and give safe and as reliable results as the nature of the construction permits.

The French method of analysis is based upon experiments which apparently show that reinforced concrete has a total elongation before rupture about ten times greater than plain concrete. Such a result if accepted must assume an inexplicable change, caused by simply imbedding steel bars in the concrete, by which its properties are radically altered: the modulus of elasticity must be reduced to one-tenth its value for plain concrete or the tensile strength increased tenfold, or both properties must be coincidently changed, one being reduced and the other increased to an extent producing the same effect. Plain concrete with an ultimate tensile strength of 300 lbs. per sq. in. and a modulus of 3,000,000 has an elongation at the ultimate of .0001 per unit length. Soft steel with an elastic limit of 30,000 lbs. per sq. in. and a modulus of 30,000,000 has an elongation of .0010 per unit of length at the elastic limit, or ten times the ultimate elongation of plain concrete. Therefore, if reinforced concrete is assumed to stretch ten times more than plain concrete it would follow, when soft steel reinforcement is used, that the concrete could be considered resisting tensile strain within the elastic limit of the steel. Some of the systems in this country using bars of special steel have unwarrantedly extended this method and assume that the concrete acts in tension without rupture within the high elastic limit of the hard steel. Such hard steel with an elastic limit of 60,000 lb. per sq. in. has an elongation per unit length at the elastic limit of .0020, and if the concrete should stretch to this extent without rupture the elongation would be twenty times greater than for plain concrete, an assumption twice as anomalous as that apparently warranted by the French method. This method has not been received in this country without serious question. The fallacy of the theory has been suspected, and recent experiments in this country have quite thoroughly proved its error. In the light of these recent experiments there does not seem to be a valid reason for assuming any change in the original properties of the component materials when acting together in mechanical combination. A reinforced concrete beam is a compound beam of two materials of different strengths and elasticities, and it is proper that rational formulas for the strength of the combination should be developed with this principle as the foundation. Accordingly, the elongation of concrete in tension at its ultimate of 300 lbs. per sq. in. corresponds to an elongation of the steel at a stress of 3,000 lbs. per sq. in. when the elastic modulus of the steel is ten times that of the concrete. As the working stress in the steel reinforcement is usually from 10,000 to 15,000 lbs. per sq. in. it follows that such stresses in the steel must produce elongations beyond the capacity of the concrete in tension. While no visible cracks may appear in the concrete, yet the cohesion of the particles has been destroyed. It is proper, therefore, to neglect the tensile strength of the concrete in transverse stress.

This article will be limited to the consideration of the simple case of concrete beams for floors reinforced with steel bars on the tension side. A plane section before bending will be assumed to remain a plane section after bending takes place, which is a usual assumption and one that seems to be experimentally warranted by the recent tests of Prof. A. N. Talbot. The tensile strength of the concrete will be neglected and the total tensile forces on the tension side of the beam will be considered as resisted entirely by the steel reinforcement. The following is the general notation employed:

b = width of the slab in inches.
d = depth of the slab in inches from the compression face to the center of the steel reinforcement.
xd = distance from the neutral axis to the compression face.
A_S = total area in square inches of the steel reinforcement in the width, b.
$n = \frac{A_S}{bd}$ = ratio of area of steel to effective area of concrete.
S = tensile stress in the steel, lbs. per sq. in., within the elastic limit.
C = ultimate compressive strength of the concrete, lbs. per sq. in.
C_1 = compressive stress, lbs. per. sq. in., in the concrete at the compression edge of the slab.
C_2 = compressive stress in the concrete at any point between the neutral axis and the extreme element.
E_S = modulus of elasticity of the steel = 30,000,000.
E_O = initial modulus of elasticity of the concrete in compression.
E_C' = equivalent modulus of elasticity of the concrete in compression between zero stress and C_1 stress.
E_C'' = equivalent modulus of elasticity of the concrete similarly for C_2 stress.
E_C = equivalent modulus of elasticity of the concrete in compression at the ultimate strength.
λ_S = elongation of a unit length of the steel produced by a stress of S.
λ_C' and λ_C'' = distortion of a unit length of the concrete produced by stresses of C_1 and C_2, respectively.
$m = \frac{E_S}{E_C'}$ = ratio between the moduli at C_1 stress.
q = factor for obtaining the sum of the compressive stresses.
rxd = distance from the neutral axis to the center of gravity of the compressive stresses.
M = moment of resistance of the reinforced section in inch lbs.
M_O = bending moment of the external forces in inch lbs.

The modulus of elasticity of the concrete in compression is not a constant quantity, as will appear from examination of any of the numerous tests made for its determination, and decreases in value as the intensity of the stress increases. The modulus corresponding to the deformation produced by a small initial stress is the initial modulus of elasticity. If the initial increment of stress is doubled, the deformation produced by the additional increment is greater than the initial increment, the difference being due to a decreased value of the modulus. In the same way the differential deformation produced by the same increment of stress increases as the total intensity of the stress increases, corresponding to a reducing value of the modulus. The total deformation between zero stress and a stress of C_1 will be the sum of the differential deformations between zero and the stress in question, or

$$\lambda_C' = \sum_{o}^{C_1} \frac{\Delta C}{E_O} + \frac{\Delta C}{E_1} + \frac{\Delta C}{E_2} + \text{etc.},$$

which can be written in the form

$$\lambda_C' = \frac{C_1}{E_C'}.$$

The E_C' in the denominator of this expression is an equivalent value for the modulus of elasticity at the stress of C_1 conditioned upon its making the value of the fraction the same as would be obtained by the summation of the differential increments between zero stress and C_1 stress. Likewise, E_C'' is an equivalent modulus of elasticity at the stress of C_2, which will give the same total deformation as would be obtained by the summation of the differential increments of deformation between zero stress and C_2 stress.

An analysis in quite general use assumes a parabolic distribution of stress over the cross-section. Referring to Fig. 1, which represents the strain and stress diagram for the compression side of a concrete beam, this theory assumes that the compressive stress diagram is bounded by a parabola aeb with its vertex at a, and that any stress at a distance zd from the neutral axis is represented by the ordinate, C_2, to this parabola. Then the area of the compressive stress diagram, or the sum of the compressive stresses is $\frac{2}{3}\, C_1\, xd$, and the center of gravity of the compressive stresses is at a distance of $\frac{5}{8}\, xd$ from the neutral axis. These values follow from the properties of the parabola. In the formulas of resistance developed from this theory some designers use the ultimate compressive strength of the concrete and divide the result by a factor of safety to obtain the safe working resistance of the reinforced slab, while other designers use the safe compressive stress of the concrete to obtain the safe working resistance directly. Either of these two methods assumes a parabolic distribution of stress for all intensities of loading, an assumption which is incompatible with the elastic properties of the concrete.

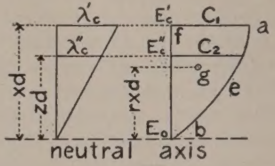


FIG. 1

From the usual stress and strain relations, referring to Fig. 1, it follows that

$$\lambda_C' = \frac{C_1}{E_C'}$$

$$\text{and} \qquad \lambda_C'' = \frac{C_2}{E_C''} = \frac{z}{x}\,\lambda_C' = \frac{z}{x}\,\frac{C_1}{E_C'}.$$

$$\text{Then} \qquad C_2 = \frac{z}{x}\,\frac{E_C''}{E_C'}\,C_1. \tag{1}$$

If the bounding curve aeb is assumed to be a parabola with vertex at a, then from the properties of the parabola

$$C_2 = \left[1 - \left(1 - \frac{z}{x} \right)^2 \right] C_1. \tag{2}$$

Equating these two expressions for C_2 and solving for E_C'',

$$E_C'' = E_C' \left(2 - \frac{z}{x} \right) \tag{3}$$

When $z = o$, then E_C'' becomes E_O and therefore

$$E_C' = \frac{1}{2}\,E_O.$$

So that a parabolic distribution of stress requires the equivalent modulus of elasticity for any stress of C_1 in the extreme element to be ½ the initial modulus. If C_1 is taken as the safe working stress, say ⅙ the ultimate, the modulus, E_C', at this working stress, must be ½ the initial modulus to comply with the theoretical condition of a parabolic stress distribution. Likewise, if C_1 is taken as the ultimate strength then the equivalent modulus at the ultimate must be ½ the initial modulus. These are conflicting conditions and not in accord with the actual behavior of the concrete. The equivalent modulus may be ½ the initial for some specific stress in the concrete, but not for all stresses.

Substituting in Equation (3) the value of $\frac{z}{x}$ found from Equation (1), and solving,

$$E_C'' = \frac{1}{2}\,E_O \left[1 + \sqrt{\frac{C_1 - C_2}{C_1}} \right] \tag{4}$$

This equation (4) expresses the variations of E_C'' required to produce a compressive stress diagram bounded by a parabola as aeb in Fig. 1. An inspection of this equation shows that E_C'' will have as many resulting values as there are assumptions of C_1, or, in other words, an infinite number of values of E_c'' for a definite stress of C_2 will be required to fulfill the conditions of a parabolic stress distribution for all intensities of stress in the extreme element of the concrete. It is evident that for the same concrete the value of E_c'' for a definite stress of C_2 should be a constant, and therefore the assumption of a parabolic compressive stress diagram for all intensities of loading is an impossibility.

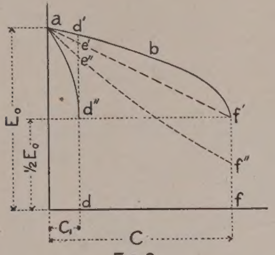


FIG. 2

Equation (4) is the expression of a parabola with its vertex at a point of which ½ E_o and the assumed value of C_1 are the co-ordinates. Thus, referring to Fig. 2, if C_1 is the safe working stress, say 1/6 the ultimate, the equivalent modulus for C_1 will be the ordinate $dd'' = \frac{1}{2} E_o$ and the equivalent modulus for stresses less than C_1 will be represented by vertical ordinates to the parabola, ad'', whose vertex is at d''. But if C_1 in Equation (4) is taken as the ultimate strength of the concrete, then $C_1 = C$ and Equation (4) may be written

$$E_c' = \frac{1}{2} E_o \left[1 + \sqrt{\frac{C - C_1}{C}} \right] \qquad (5)$$

The value of E_c' for any stress of C_1 will then be represented by a vertical ordinate at a distance of C_1 from the origin to the parabola abf', whose vertex is at f'; the equivalent modulus at the ultimate will be the ordinate $ff' = \frac{1}{2} E_o$ and the equivalent modulus for any intermediate stress of C_1 will be represented by the ordinate dd' to this parabola. In the first case E_c' for the stress C_1 is represented by the ordinate dd'', and in the second case by the ordinate dd', two widely different values of the same constant quantity.

Equation (5) gives only one value of E_c' for a specific stress of C_1 and is consequently a consistent expression, but it corresponds to a parabolic distribution of stress only when the stress in the extreme element is the ultimate strength of the concrete; in which case the parabola abf' in Fig. 2 represents the equivalent modulus, having a value of ½ E_o at the ultimate, and values of the equivalent modulus for intermediate stresses being represented by ordinates to this curve, as dd' for C_1 stress. This is the form in which the assumption was originally proposed, derived from a consideration of the stress-strain curve appearing to be a parabolic curve, in which special case the analysis would be correct, but only at the ultimate strength of the concrete. The analysis has been misapplied and the assumption improperly used in calculating the transverse strength at all intensities of stress. The curve *aeb*, Fig. 1, bounding the compressive stress diagram, would be a parabola only when the stress in the extreme element is the ultimate strength of the concrete; but at the safe working limit the curve *aeb* becomes nearly a straight line and the compressive stress diagram becomes nearly a triangle. The practical error in the misapplication of this analysis results in actual working stresses in the concrete as much as 40 per cent. greater than the designer intended to permit.

The analysis of a reinforced concrete beam for all intensities of loading requires the law of variation of the equivalent modulus of the concrete to be known. Such an assumed law of variation is represented by equation (5), in which the equivalent modulus at the ultimate becomes one-half the initial modulus, and for intermediate stresses is represented by ordinates to the parabola abf' in Fig. 2. This hypothesis is based upon the assumption that the stress-strain curve relation is a parabola with its vertex at the point of failure. Thus in Fig. 4 if the stress-strain curve is the dotted line abe'', a parabola with its vertex at e'' or at the point of average normal ultimate strength, then the variation of E_c' expressed by Equation (5) will result. Sometimes the stress-strain curve nearly assumes this parabolic form, but in the greater number of recorded tests the curve cuts the lines of stress values at an acute angle at the ultimate like the curve ade'' in Fig. 4, and is a flatter curve than a parabola. A further objection to the hypothesis is that it lacks extensibility. The parabola abe'' in Fig. 4 representing the stress-strain relation gives imaginary values for the deformation of samples whose strength exceeds the assumed average normal ultimate; likewise the resulting parabola abf' in Fig. 2 representing the equivalent modulus gives imaginary values of the modulus when the ultimate strength exceeds that assumed as the basis of the analysis.

While the numerous tests of the strength and elasticity of concretes made by various experimenters reveal an extremely wide variation in results, yet some general relations are approximately true. The deformation for an increment of stress near the ultimate load is about four times the deformation for the same increment of stress at the beginning of loading. The rate of deformation is not constant, but increases as the intensity of stress increases, and at the ultimate the rate of deformation appears to be four times the initial rate at the commencement of loading. The instantaneous modulus at the ultimate, therefore, appears to be approximately one-fourth the initial modulus. The total deformation when the ultimate is reached is in general about double that which would be due to the initial modulus if it applied throughout the loading. Thus in Fig. 4 if the initial modulus applied to all intensities of stress the deformation would be represented by the straight line aa', and the total deformation at the assumed normal ultimate strength of the concrete would be ee' instead of the actual deformation, ee'', the latter being double the former. This corresponds, in accordance with the definition of the term, to an equivalent modulus at the ultimate strength of one-half the initial modulus, the same value at the ultimate as that given by the ratio expressed by Equation (5). The law of variation represented by Equation (5) is a parabola concave toward the origin, but in many tests the curve representing the equivalent modulus is convex toward the origin. At the initial stress the equivalent modulus is, of course, the same as the initial modulus, and in the analysis which follows it will be assumed that at the ultimate it is reduced to one-half the value of the initial modulus, the intermediate variation being represented by a straight line relation between these extremes. The straight line, af', in Fig. 2, represents this proposed variation of the equivalent modulus, the equation of which, complying with the assumed conditions, will be

$$E_c' = E_o - \frac{E_o}{2C} C_1, \qquad (6)$$

from which the value of E_c' for any stress of C_1 is obtained. The line af'' in Fig. 2 represents the corresponding instantaneous modulus. The total deformation at C_1 stress will be

$$\lambda_c' = \frac{C_1}{de'},$$

and the additional deformation for a small increment of stress will be

$$\Delta \lambda_c' = \frac{\Delta C_1}{de''},$$

in which de' represents the equivalent modulus corresponding to C_1 stress and de'' the instantaneous modulus at C_1 stress. As the instantaneous modulus does not enter directly into the formulas for transverse strength it will be unnecessary to consider its properties, but the corresponding equivalent modulus governing the total deformation at a given stress is one of the principal factors in the analysis. The hypothesis here proposed for the value of this equivalent modulus expressed by Equation (6) is as consistent with the properties of concrete as is warranted by present knowledge, considering the extremely wide variation of results exhibited by experimental data on the subject.

The average ultimate strength of Portland cement stone concretes at an age of three months will be taken as expressed by the equation

$$C = 4{,}500 - 250 f, \qquad (7)$$

in which f is the ratio of sand and stone to cement. The initial modulus will be taken as expressed by the equation

$$E_o = 1{,}200\, C. \qquad (8)$$

Regarding the adoption of these values reference is made to the recent book on "Cements, Mortars and Concretes," by Myron S. Falk, Ph.D., in which, on pp. 134-135, similar equations are given for these properties as representative of a large number of tests from numerous sources. In adopting the modified equations here proposed the tests of European concretes have been excluded and the resulting relations expressed in even figures. The properties of some of the common proportions of concretes will then be as follows:

Concretes.	Ultimate Strength. C	Initial Modulus. E_o
1:2:4:	3,000	3,600,000
1:2:5:	2,750	3,300,000
1:3:5:	2,500	3,000,000
1:3:6:	2,250	2,700,000

The equivalent modulus from Equation (6) will be uniformly expressed for these concretes in the form

$$E_c' = E_o - 600\, C_1 \qquad (9)$$

It is to be noted that the relations expressed by equations (7), (8) and (9) are for Portland cement stone concretes.

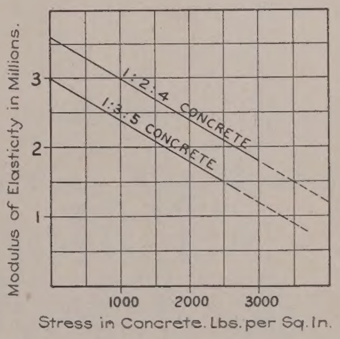


FIG. 3 Equivalent Modulus of Elasticity.

Fig. 3 shows the proposed straight line variation of the equivalent modulus resulting from equation (9) for 1:2:4 and for 1:3:5 concrete. Similar lines can be drawn for other proportions of concrete.

In Fig. 4 the small circles indicate deformations in compression of a 1:2:4 concrete sample plotted from the Watertown tests. If the initial modulus applied throughout the deformations would be represented by the straight line, *aa'*. The theoretical deformation resulting from the application of the proposed theory of the equivalent modulus derived from equations (7), (8) and (9) is represented by the curved full line, *ade''*, which follows very closely the actual observed distortion. Similarly Fig. 5 shows a comparison of the proposed theory with tests of 1:3:5 concretes.

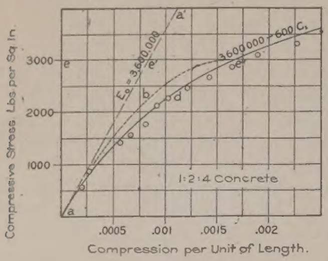


FIG. 4 Stress-Strain Diagram for 1:2:4 Concrete.

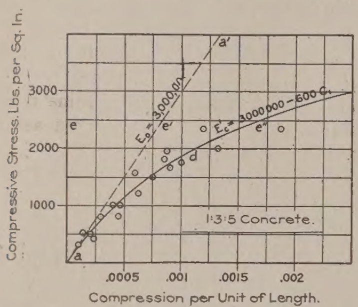


FIG. 5 Stess-Strain Diagram for 1:3:5 Concrete.

In accordance with this proposed theory of elastic properties of the concrete the variation of stress in the cross-section will now be determined. Referring to Fig. 1, from the usual stress and strain relations,

$$\lambda_c' = \frac{C_1}{E_c'}$$

and

$$\lambda''_c = \frac{C_2}{E_c''};$$

also

$$\lambda_c'' = \frac{z}{x} \lambda_c'.$$

Then

$$\frac{C_2}{E_c''} = \frac{z}{x} \frac{C_1}{E_c'}.$$

From equation (9) the values of E_c' and E_c'' are

$$E_c' = E_0 - 600\ C_1$$
$$E_c'' = E_0 - 600\ C_2.$$

Then solving for C_2 its value is obtained:

$$C_2 = \frac{1}{1 + \frac{E_c'}{E_0}\left(\frac{x}{z} - 1\right)} . C_1 \qquad (10)$$

This equation gives the intensity of stress in any element at a distance of *zd* from the neutral axis. The coefficient of C_1 in this equation has the same value for all concretes whose elastic property is expressed by equation (9) when C_1 is the same proportion of the ultimate strength. Thus if C_1 is taken as the ultimate then the resulting values of the coefficient will be found to be identical for concretes of varying strength. In the same way, if C_1 is taken as one-sixth the ultimate, then new values for the coefficient will result, but they will be equal for all concretes to which equation (9) applies when the stress in the extreme element is the same proportion of the ultimate

The form of the curve *aeb* in Fig. 1 bounding the compressive stress diagram at varying intensities of stress, is determined by the values of C_2 found from equation (10). When this curve is known the area of the compressive stress diagram and the position of its center of gravity can be computed, but the mathematical operation is complicated. A sufficient number of values of C_2 obtained from equation (10) can be computed to determine the curve *aeb*, and from these values the area of the corresponding compressive stress diagram and the position of its center of gravity calculated with sufficient exactness for practical purposes. The area of the figure *abf* in Fig. 1 may be written

$$\text{Area} = q\ C_1\ xd,$$

in which *q* is a factor depending upon the form of the curve *aeb*. The position of the center of gravity is indicated at *g* at a distance *rxd* from the neutral axis. Values of *q* and *r* are given in the following table for varying intensities of stress in the extreme element of one-fifth, two-fifths, etc., of the ultimate. For intermediate intensities of stress the values may be interpolated:

Stress in Extreme Element.	Values of *q* and *r*. *q*	*r*
$C_1 = 1/5\ C$	.517	.661
$= 2/5\ C$	.537	.655
$= 3/5\ C$	.559	.647
$= 4/5\ C$	.584	.639
= Ultimate	.613	.630

These values are shown in Fig. 6 to 1:2:4 and 1:3:5 concrete. For other proportions of concrete the curves of *q* and *r* remain the same, and similar diagrams can be drawn.

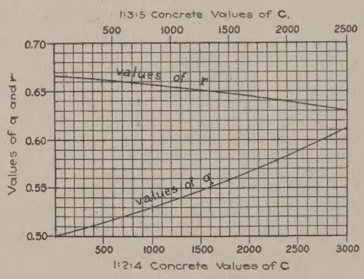


FIG. 6 Values of q and r

A comparison of the form of the compressive stress diagram at varying intensities of stress resulting from the method here proposed is shown in Fig. 7, in which the full lines represent the bounding curve when the stress in the extreme element is the ultimate, also when it is ⅓ and ⅔ the ultimate. At the working stress it will be noted that the compressive stress diagram becomes nearly a triangle with its center of gravity at *g*, but as the intensity of stress increases the bounding curve becomes more concave and at the ultimate assumes the form shown, while the center of gravity has moved to *g'* as the limit. The parabola shown by the dotted line represents the bounding curve assumed by some authorities and which has been previously discussed.

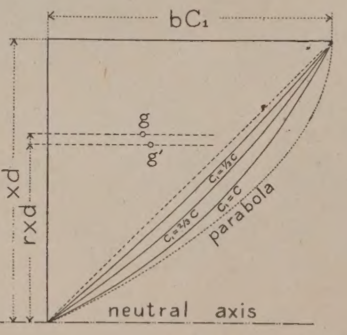


FIG. 7 Comparative Forms of the Compressive Stress Diagram at Different Intensities of Stress.

The formulas for transverse strength will next be developed in the customary manner. Referring to Fig. 8, from the usual stress and strain relations,

$$\lambda_c' = \frac{C_1}{E_c'}$$

and

$$\lambda_s = \frac{S}{E_s},$$

$$\lambda_c' = \frac{x}{y} \lambda_s = \frac{x}{1-x} \lambda_s.$$

Then

$$\frac{C_1}{E_c'} = \frac{x}{1-x} \frac{S}{E_s}$$

and

$$x = \frac{1}{1 + \frac{E_c'}{E_s} \frac{S}{C_1}}, \qquad (11)$$

which determines the position of the neutral axis when *S* and C_1 are assumed.

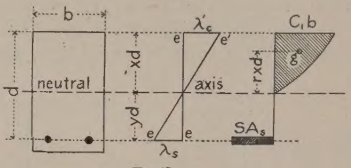


FIG. 8

As the sum of the compressive stresses on the compression side of the neutral axis equals the sum of the tensile stresses on the tension side, therefore, neglecting the tension in the concrete,

$$q\ C_1\ bxd = S\ A_s$$

and

$$A_s = q \frac{C_1}{S} bxd. \qquad (12)$$

It is customary to express the area of steel as a percentage, in which case

$$A_s = nbd$$

and equation (12) will then become

$$n = q \frac{C_1}{S} x. \qquad (13)$$

When *S* and C_1 are assumed the area of steel reinforcement required is obtained from equation (12) or from equation (13) in the form of a percentage. The value of *x* given by equation (11) is to be used for this purpose.

The sum of the moments of the compressive and tensile stresses around the neutral axis is the transverse moment of resistance of the section, from which it follows that

$$M = (q\ C_1\ bxd)\ rxd + (S\ A_s)\ yd.$$

Reducing this expression to terms of C_1 and also to terms of *S*, there will result

$$M = q\ C_1 x\ [1 - x\ (1 - r)]\ bd^2 \qquad (14)$$
$$M = S\ A_s\ [1 - x\ (1 - r)]\ d \qquad (15)$$

If the area of the steel is stated as a percentage the last equation becomes

$$M = n\ S\ [1 - x\ (1 - r)]\ bd^2 \qquad (16)$$

These expressions for the moment of resistance are in convenient form for calculation; *q*, *r* and *x* are ratios. The values of C_1 and *S* are assumed, the value of *x* is obtained from equation (11), the area of steel from equations (12) or (13) and q and r taken to correspond with the value of C_1 assumed. For 1:2:4 concrete, if the stress C_1 in the extreme element is to be 1/5 the ultimate, or 600 lbs. per sq. in., and the stress in the steel 12,000 lbs. per sq. in., then these equations give the following results:

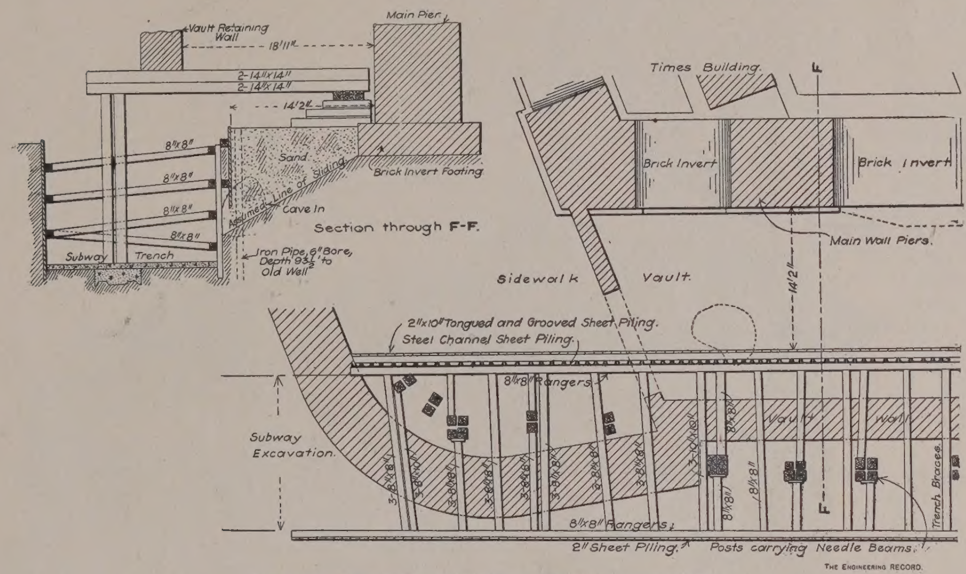
$$xd = 0.3165\,d,$$
$$A_s = .00818\,bd = \text{about } 8/10 \text{ per cent},$$
$$M = 87.68\,bd^2.$$

Equations (14) and (16) for convenience may be written in the form

$$M = K\,bd^2, \tag{17}$$

in which K represents the value of the actual coefficient of bd^2 given in detail for the respective equations.

(To be continued.)



Steel Sheeting Protecting Times Building Foundation.

The Shifting of Mains of Private Corporations.

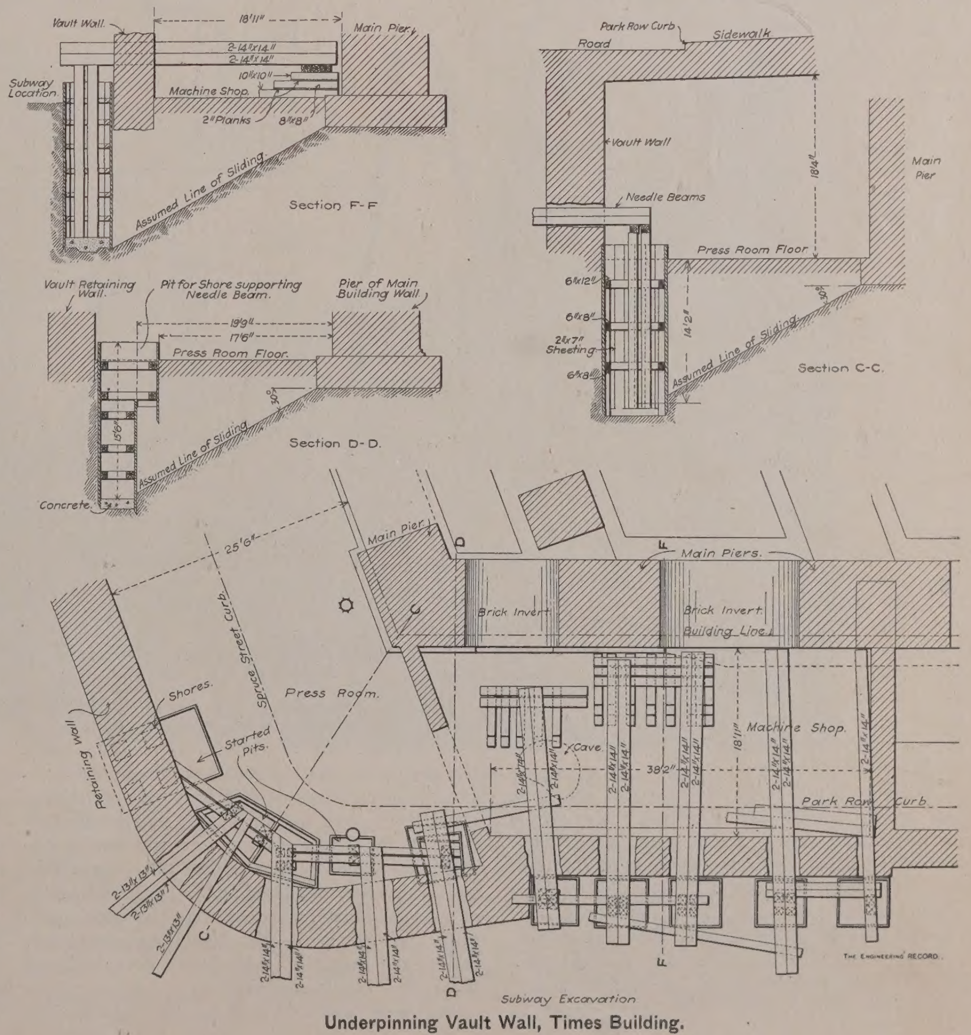
The shifting of mains belonging to private corporations, although located in public streets, is sometimes made necessary by the construction of sewers or other works requiring trenching. As a rule all such changes are made without charge to the owners of the mains, but the U. S. Supreme Court has just decided in Gas Light Co. v. New Orleans Drainage Commission, that the owners must bear the expense in such a case. The two points argued were decided as follows, 25 Sup. Rep. 471: "The imposition on a gas company of the cost of changes in the location of its pipes and mains under the city streets, necessitated by the construction of the municipal drainage system, does not impair any contract rights acquired under its exclusive franchise to supply gas to the city and its inhabitants through pipes and mains laid in the city streets. A gas company has no such property right in the location of its pipes and mains laid under an exclusive franchise to supply gas to the city and its inhabitants, as to make the imposition upon it of the cost of changes in the location of such pipes and mains, necessitated by the construction of the municipal drainage system, a taking of property without due compensation."

The Apparent Unreliability of the steel cable in hoisting operations is the result of the use of too small sheaves over which the steel cable has ordinarily been worked. It has been the tendency to so reduce the diameters of the sheaves as to introduce undue stresses upon the cable in turning. If the sheave diameter be not less than forty times the diameter of the cable, no difficulty will be experienced from breakages.

Underpinning and Protecting the Foundations of the Times Building, New York.

The Times Building, at the corner of Spruce St. and Park Row, New York, was formerly used as a newspaper publishing house and was then 12 stories high with massive self-supporting front walls of brick and stone masonry, which have their foundation piers seated about 22 ft. below the curb on inverted brick arch footings resting 26 ft. below curb level and about 10 ft. above ground water line on a very deep bed of gravel, sand and quicksand reaching to rock 103 ft. below the curb. The sidewalk vault, which is two stories high, extends 25 ft. in the clear beyond the building line, and has outside a heavy curved vertical masonry retaining wall with inner air space and brick lining. This wall has a maximum thickness of about 6 ft., a height of about 25 ft. to the bottom of the continuous masonry footings, and, like that of the main building, is on sand. The vault was used as a pressroom, containing a number of massive printing presses in daily operation and for machine shop, boiler room and coal storage, so that a large portion of it was occupied by delicate or heavy plant that could not be displaced or disturbed.

The two-story steel and concrete structure for the City Hall loop of the Rapid Transit Subway passes through and under a portion of the vault, and made it necessary to excavate there to a depth of about 15 ft. below the pressroom floor and 12 ft. below the footings of the main wall piers. This and the other operations of building the subway made it necessary to underpin the outside heavy vault wall and to provide against the possibility of undermining the main wall piers. The vault wall was underpinned by the ordinary needle beam methods, using timbers of unusual dimensions. Various modifications were developed at different points of the wall, but in general the method was to cut a hole through the masonry at the level of the basement floor and insert through it four long 14 x 14-in. pine timbers clamped together to have a 28 x 28-in. cross section. These were at first supported on sills or blocking at both ends and firmly wedged against the under side of the masonry in the usual manner. Where there was clearance to carry the timbers across the vault, they were supported there permanently on the sills, which distributed



Underpinning Vault Wall, Times Building.

the load over a sufficient area to reduce the load on the floor to suitable unit pressure. In some instances the ends of the timbers could not project far beyond the inner surface of the wall and were only temporarily supported there by the sills. The outer ends of most of the beams were also at first temporarily supported on sills laid on the bottom of the pit, which at that time was excavated no deeper than the floor of the vault.

In order to provide for the support of the needle beams while the excavation was being continued, pits about 5 or 6 ft. square were sheeted down to the required depth on both sides of, and close to the wall, as indicated by the plan and cross-section and during their excavation the needle beams were supported above them on the temporary sills until groups of 12x12-in. vertical posts were set on them and carried the loads down below the level of final excavation, thus relieving the temporary sills and making it immaterial whether the earth under them and around the wall was removed. Before setting the posts in the sheeted pits the bottoms of the latter were covered with permanent concrete footings carried down below subgrade in the subway loop. Special care was taken to design these footings with bottoms recessed as shown in the cross-section and intended to distribute the loads on the sand in a divergent manner calculated to reduce possible settlement. In some cases the needle beams were carried directly on top of the vertical posts and in others horizontal timbers were interposed, supporting the needle beams eccentric from the posts.

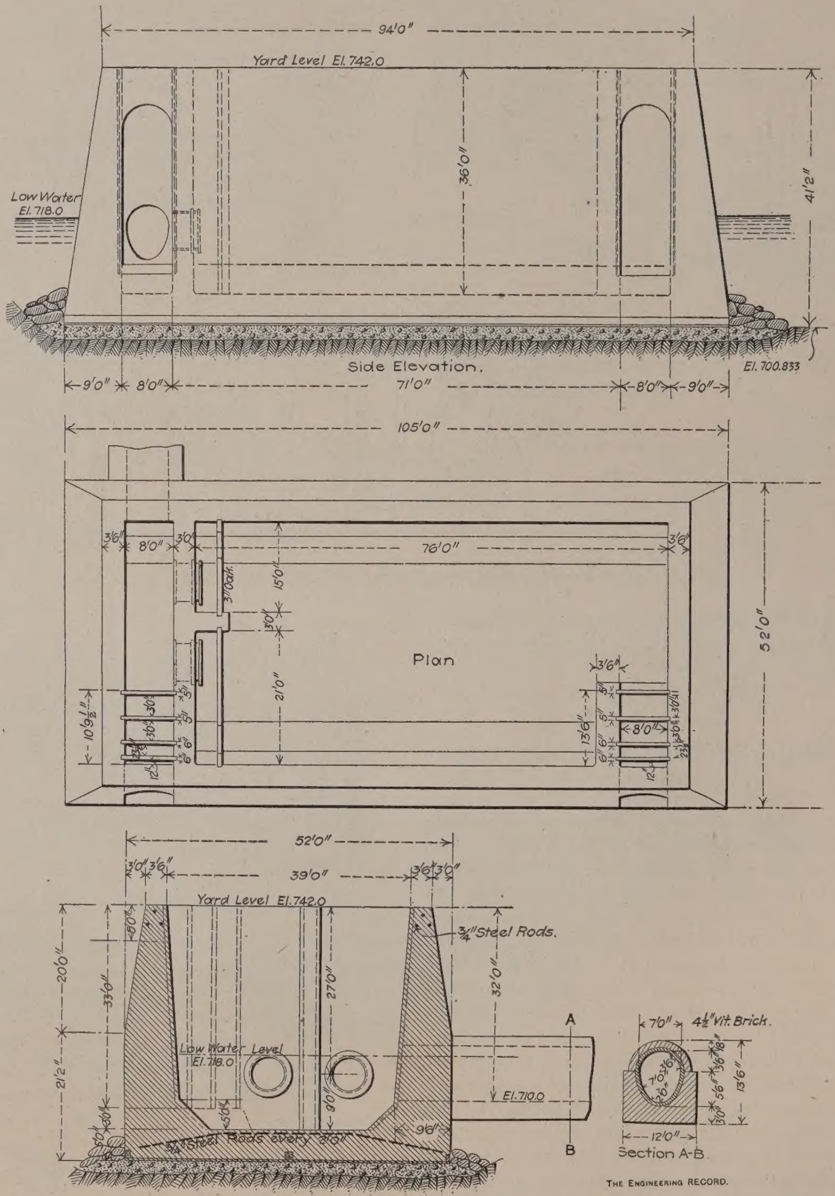
It was assumed that the angle of stability of the sand excavated was 30 deg., which in most cases located the line from the toe of the pier footings above the subway excavation; in some instances it was about 4 ft. above the excavation, and for this reason and because of the uncertainty of the assumption, the danger from vibrations from unforeseen disturbances and the great weight and height of the building, it was deemed necessary to provide against the possibility of any flow of sand into the excavation.

It was at first proposed to drive wooden sheet piles between the subway and the foundations and brace them from the trench as the excavation was made. The Park Co., the owners of the building, through their architect, Mr. Robert Maynicke, protested against the use of any wooden sheeting, because, if it was made permanent, its inevitable decay would cause dangerous voids which would be filled with sand undermining the footings. The footings were then loaded about 800 tons each, an amount since increased about 20 per cent. by the addition of four more stories on the top of the building, and it was felt that there was little certainty of the way in which the sand would act on an exposed inclined surface adjacent to and below the footings, or what angle of stability would prove to be the minimum under these conditions. After prolonged conferences with engineers representing the Rapid Transit Commission, the Subway Construction Co. and the contractor, in which various expedients were suggested and disapproved, Mr. Maynicke proposed the use of a wall of steel sheet piles, of which the use for such purposes had not at that time been recorded. Several types were suggested, but the one finally approved by Mr. Maynicke consisted simply of channel bars from 10 to 15 in. wide.

Ordinary 2-in. tongue-and-groove sheathing was first driven through the vault floor outside the line of the subway and excavation was made beyond it around under the footings of the vault wall to a depth of about 5 ft. In this trench a continuous line of 10-in., 12-in. and 15-in steel channel bars about 15 ft. long were driven vertical with their flanges in contact and the back of their webs forming a smooth continuous surface on the subway side. They were driven by hand with heavy mauls, and their lower ends were always kept from 1 to 2 ft. below the bottom of the excavation, which was continued as the channels were driven. As fast as they were driven the joints were calked watertight with oakum. Ordinary wooden sheet piles were simultaneously driven on the opposite side of the subway trench beyond the vault walls, and as fast as the earth was removed the usual type of rangers and cross braces were placed to transfer the pressure from one side to the other and support the sheeting as shown in the cross-section. In this manner a solid steel wall was interposed between the subway and the sand which supported the footings of the wall piers.

The channels were driven so closely together that no sand whatever escaped through the joints after calking. An inspector was on duty, night and day, to see that the piles were always driven in advance of the excavation. A firm and a practically imperishable wall was thus made outside the subway with no danger of decay to create cavities into which the sand at some future time might flow and undermine the building. The short lengths of wooden sheathing adjacent to the upper parts of the channels are so far above the assumed flow line of the sand that their future decay can not jeopardize the foundations.

The work was executed by the Degnon Contracting Co., which was the contractor for the subway construction at this point, Mr. Francis D. Fisher, chief engineer.



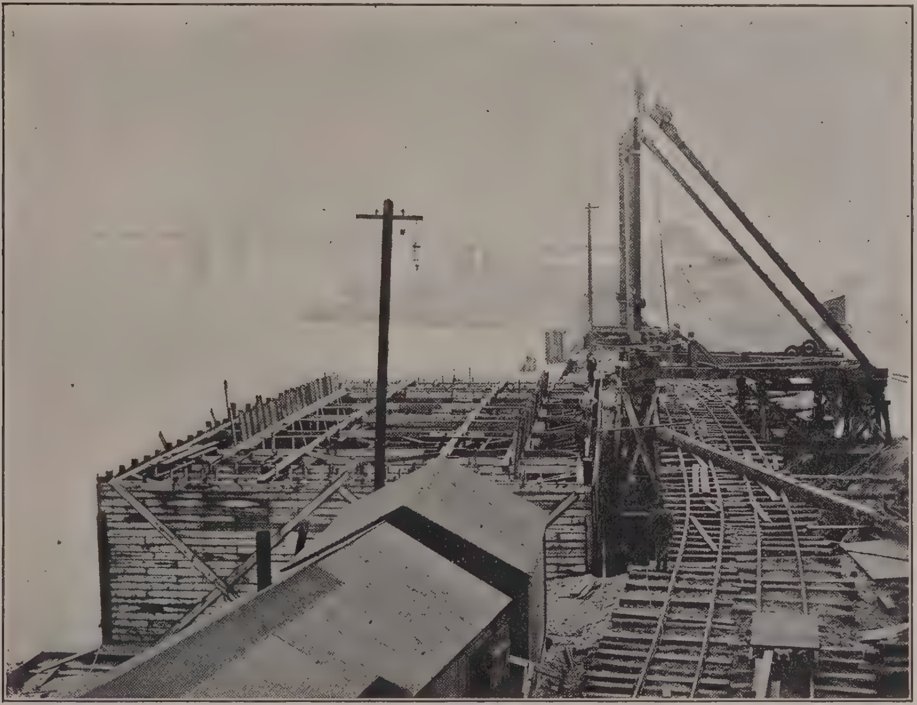
General Details of Concrete Settling Basin at McKeesport, Pa.

Economy of Modern Shops.

The economy of modern shop facilities is attested by the results obtained from the new repair shop plant of the Pittsburg & Lake Erie R. R. at McKees Rocks, Pa., which has now been in full and successful operation for over a year. Although a great many more locomotives have been repaired during the past year in the new shops than during the year preceding in the old plant, the total cost of operation has been considerably less. It is stated that if the same number of locomotives as overhauled in the new shops had been repaired under the old shop conditions, the cost would have been $240,000 more; in other words, the direct result of operation in the new shop plant is an absolute saving in the first year of $240,000, which is over 15 per cent. of the original cost of the shops. This account of saving does not include the indirect economies resulting from the general better condition of the locomotive equipment, the smaller amounts of time for each locomotive out of service, the greater conveniences for the workmen, etc.

A Concrete Settling Reservoir at McKeesport, Pa.

The boilers and the hydraulic machinery of the McKeesport, Pa., plant of the National Tube Co., are supplied with water which was formerly drawn directly from the Monongahela River by pumps in a station building connected with the plant. The river water contains a large amount of suspended matter which seriously interfered with the operation of the plant, so a large open concrete settling basin, with a capacity sufficient to remove the greater part of the sediment, has been built in the river bank adjacent to the pumping station.



Caisson Anchored in Position before Concrete Laying was Begun.

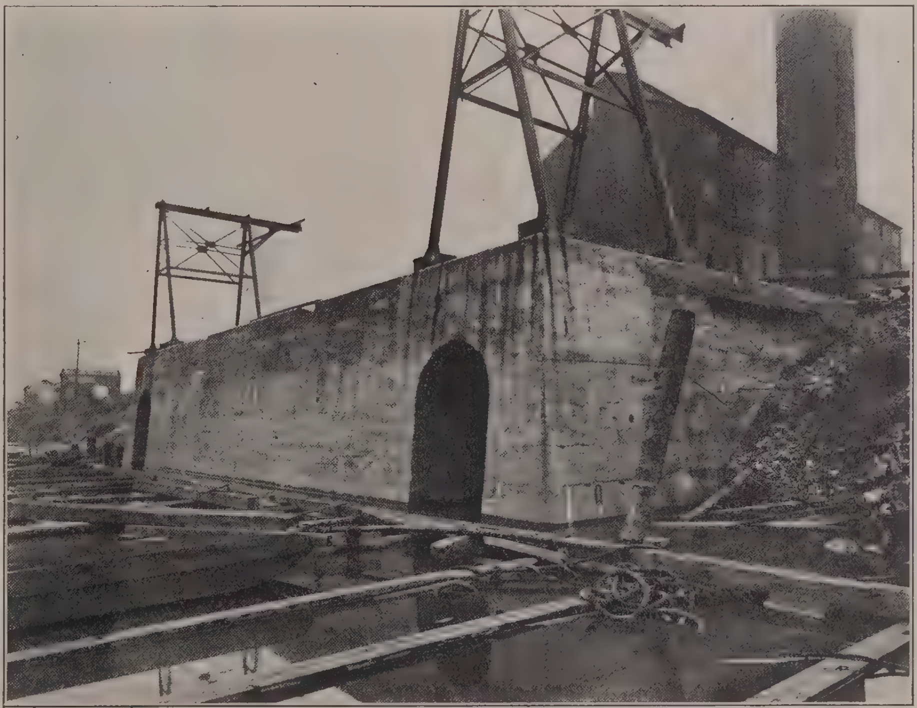
The basin is 52x105 ft. in plan and 41 ft. 2 in. high, built of monolithic concrete, with very little steel reinforcement. It is arranged with an 8-ft. inlet opening extending nearly to the top of the outer wall at the upstream corner and is connected at the inner downstream corner with an egg-shaped concrete conduit leading to the pumping station. A concrete wall extends transversely across the basin 8 ft. from the lower end, forming an outlet chamber. Two 5-ft. pipe openings through this wall connect the basin with the outlet chamber. These openings are provided with grooves for stop planks and the basin may be by-passed and water drawn directly from the river through an 8-ft. opening to the outlet chamber in the outer wall at the downstream corner. The walls at both openings into the river are also built with grooves in them in which stop planks may be used to close the openings. Bar gratings and coarse screens are operated in similar grooves. A light steel tower carrying a traveling hoist, with which the stop planks and screens are handled, is built over each set of grooves.

Trouble in securing adequate foundations occasioned considerable difficulty in the construction of the basin. The basin is built parallel to the stream with its outer edge on the new harbor line, which is 30 to 35 ft. outside of the old harbor line and about the same distance from the edge of the water when the pool formed by a dam some distance downstream is filled. The original plan for carrying on the construction was to excavate as much of the river bank as necessary and level the bottom with dredges, build a cofferdam around the site and then drive a pile foundation, with a timber grillage over the piles to carry the basin. Careful soundings disclosed a good bottom slightly below the surface of the river bed, so it was decided to alter the plans and build the basin in an open caisson as a considerable saving could thus be made. The mud and silt were first removed to the firm foundation and the bottom leveled with dredges. A 2-ft. layer of gravel was then spread over the bottom and extended 5 ft. beyond the site of the caisson on all sides.

The general details of the timber caisson are shown in the accompanying illustrations. The caisson was built about three miles from the site of the work and towed to position by a sternwheel river boat. It was then carefully placed and anchored and concrete laying begun. The concrete was laid uniformly so the caisson was always submerged to an equal depth on all sides and when it touched the bottom it settled practically level. Work on the walls and floor was continued until about 3,000 cu. yd. of concrete had been placed and the walls had reached a height of about 20 ft. above the foundation, when the basin settled unequally, the inner upstream and the outer downstream corners sinking below the level of the remainder of the caisson. Cracks extending diagonally across the basin and running to the bottom of the caisson immediately began to appear.

The unequal settlement and the appearance of the cracks demonstrated that the foundation would not support the basin, so it was decided to adopt the original plan and provide a pile foundation. It was considered that it would be entirely feasible to repair the cracks, dig out enough concrete to float the caisson, then tow the caisson out of place and prepare the foundation. These plans were carried out and when about half of the concrete had been removed the top of the caisson floated about 12 in. above the surface of the water. A special channel was then dredged to a site above the work where a harbor was excavated and the caisson towed into it and anchored.

Unslaked lime was largely used in breaking out the concrete as it was believed that if explosives were employed the basin might be shattered and sunk. Holes were drilled in the concrete with rock drills and a small pipe placed in each hole with its lower end about 1 in. from the bottom. The holes were then filled with lime, which was thoroughly tamped around the pipes. Water was poured in through the pipes, the pipes immediately withdrawn and the hole filled at the top and sealed with well-tamped clay. The lime in slaking broke out considerable concrete, but a few light charges of dynamite were required before enough concrete was removed to float the caisson.



Completed Basin Showing Steel Towers for Screen and Stop-Plank Hoists.

After the caisson had been removed the river bottom at the basin site was dredged to a depth of about 2 ft. below the surface of what was at first considered the top of the firm foundation, and then seven hundred 35-ft. white oak piles were driven. The pile-driver was equipped with a No. 2 steam hammer made by the Vulcan

Iron Works, of Chicago, a Mundy hoisting engine and a special follower rig.

The follower rig was made up of two 7-in. steel channels, 16 ft. long, one channel fitting on the inside face of each of the regular vertical hammer leads. The channels were cross-braced in position with angles and were kept vertical by a heavy hollow cylindrical guide casting suspended from their lower ends. The casting was supported by wire ropes rigidly attached to the steel frame work, but attached to heavy spiral springs on the casting. Space was provided above the casting and between the grooves in it, through which the channels passed, and the channels to permit the casting to rebound from the blows of the follower without damaging the rig. The follower was an extra heavy 12-in. seamless steel tube filled with an oak stick and fitted with an oak cap between the top of the tube and the cap forging. Extended wooden leads were not required with this rig and a follower was successfully used with the 16-ft. channels when only 2 ft. of the channels remained on the hammer leads. The 12-in. tube was also used successfully in preventing the follower sticks from splitting.

The piles were cut off with a submerged 48-in. circular saw driven by an Erie engine. Indicating the engine during operations it was found that 11.75 h.p. was required to operate the saw out of the water, the engine running 165 r.p.m. With the saw blade cutting a pile 6 in. under water, at a speed of 150 r.p.m., 57 h.p. was required, and with the saw cutting a pile 19 ft. under water and the engine running 135 r.p.m., 58 h.p. was required.

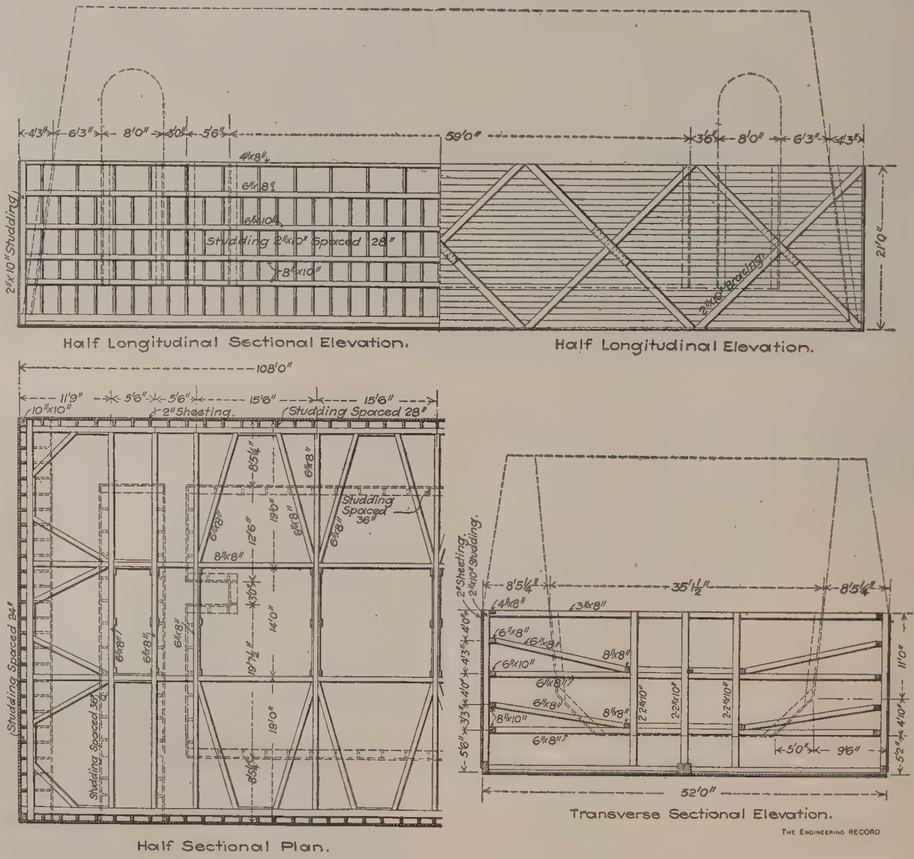
The 54x107-ft. grillage placed over the tops of the piles after they had been sawed off, was built of three layers of 6-in hemlock. It was assembled in the water near the site, towed into position and sunk by weighting it with 90 tons of pig iron in concrete placing boxes. Holes were bored in the timbers of the grillage on about 3-ft. centers and when the grillage had been lowered into place it was drift-bolted to the tops of the piles. The drift-bolting was done with the assistance of a diver as about 22 ft. of water covered the grillage. The diver would feel through each hole with a rod and if the rod showed a pile under the hole he would place a drift bolt and the bolt would be driven from the surface by raising and dropping a 2½-in. iron bar through a pipe. When the grillage was securely fastened to the piles the boxes of pig iron were removed by derricks.

The caisson was then towed back into position and after being securely rebraced was ready to be sunk again. It had to be lowered 7 ft. and as it was calculated that 1,200 tons of pig iron would have been required to accomplish this, it was filled with water through tap holes and safety gates. When the caisson came to rest on the grillage there was less than one-half inch difference in elevation between the two diagonally opposite corner posts.

A berme was then thrown up by a dredge boat from the outer corners of the caisson to the nearest point on the bank and light sheeting driven in it by hand to form a cofferdam between the caisson and the bank. The cofferdam thus formed was pumped out to reduce the buoyancy of the caisson and also to permit work to be started on the tunnel connecting the basin with the pumping station. The tunnel was below river level and much trouble was experienced in pumping the water in the cofferdam down to the working level, due to the porosity of the slag which forms the river bank at this point. The inside of the basin was connected with the cofferdam so the water was pumped from both at the same time. After the basin was emptied it had to be quickly refilled twice to prevent it from floating, as water had suddenly flooded the coffer by breaking under the grillage. These leaks were stopped by piling gravel along the outside of the caisson and, although no further trouble was experienced, the difficulty with which the water was kept out of the small cofferdam demonstrated that an attempt to build the basin in the dry with cofferdams would have resulted in much trouble from leaks through the porous bed and bank of the river.

The forms in the basin were straightened up after the water had been pumped out. All loose concrete was then removed, the cracks thoroughly grouted and filled with rich concrete and concrete laying begun again.

The construction of the tunnel through the slag in the river bank was carried on with considerable difficulty as a black quicksand was encountered and much trouble was experienced in keeping the heading pumped out. The tunnel arch was driven first and timbered. The excavation for the side walls and invert was then made and underpinned. The concrete was laid as the excavation progressed and kept as near to the heading as possible to avoid danger of cave-ins.



Half Longitudinal Sectional Elevation. Half Longitudinal Elevation.

Half Sectional Plan. Transverse Sectional Elevation.

THE ENGINEERING RECORD

Details of Timber Caisson and Arrangement of Concrete Forms.

The concrete in the basin was mixed wet in the proportions of 1:3:6 and in the tunnel about 1:2:5 of Lehigh and Alpha Portland cement and gravel and sand dredged from the bed of the river. No plastering was done as the concrete as mixed and laid was practically waterproof. The sand and gravel were hoisted from flats with a 1⅝-yd. Hayward clamshell bucket to bins over an elevated concrete mixer platform. This platform was built in the immediate foreground of the view shown of the basin during construction and spanned the two narrow-guage tracks. The concrete was mixed in a 5-ft. K. & G. cubical mixer driven by an Erie engine. The mixer discharged into a 2-yd. Cyclopean bottom-dumping bucket on a flat car on the track beneath the platform and the cars were pulled under either boom of a double traveling derrick by a winch line from one of the hoisting engines on the traveler. The buckets were then elevated and dumped with derricks on the traveler. This traveler was built specially for the work and a view of it during construction is shown in one of the accompanying illustrations. It consisted of a 30x30-ft. elevated platform with a stiff-leg bull-wheel derrick at each outer corner, the derricks having 30-ft. masts and 55-ft. booms with the masts cross-braced together and guyed to the platform. One derrick was operated by a Carlin and the other by a Lidgerwood hoisting engine. With the contractor's plant arranged and equipped as described as many as one hundred and thirty 2-yd. batches of concrete were placed in a 10-hr. day.

The settling basin and the tunnel were built by the Dravo Contracting Co., of Pittsburg, Pa.

Efficiency of Mechanical Stokers.

The efficiency of the mechanical stoker was indicated in recent tests made by the Babbington Coal Company, Derbyshire, England, with a Bennis stoker and compressed-air self-cleaning furnace. Five very low grades of coal were used, including black shale chippings, "smudge," etc., with the result that the hand-fired furnace used, in comparison with that equipped with the stoker, proved much less effective and would not burn the lowest grades. The stoker was successful in burning all grades and with black shale chippings evaporated 7.07 lb. of water from and at 212° F. per pound of fuel.

THE 8,000,000-GAL. PUMP to be built for the Montgomery, Ala., water works by the Allis-Chalmers Co. will be of the horizontal, duplex, double-acting type with a cross-compound steam end. A special arrangement of Reynolds-Corliss valve gear has been designed for the engine, with independently adjustable cut-offs for each cylinder, the high-pressure gear also being under the control of an adjustable speed governor.

Details of Blackwell's Island Bridge Superstructure.—II.

The main posts of the great bents on Piers 2 and 3, at panel points 57 and 75, respectively, are each made as before stated in nine shop-riveted sections of about 19½ ft. length and 1,250 sq. in. cross section, with square butt joints spliced by double cover plates with all rivets field driven and proportioned to transmit all stress with an excess of about 15 per cent. above the number required for the same duty if shop driven. The posts are built up entirely of plates and angles, and have a closed rectangular cross section with four webs transverse to the axis of the bridge. The posts have a uniform width of 64 in. over all from top to bottom in the plane transverse to the bridge axis, but in planes parallel with the bridge axis vary from 7 ft. in width at the top and bottom to 12 ft. in the center. This irregularity in the dimensions causes slight variations in the cross sectional areas and is secured by increasing the widths of the cover plates. The cover plates are made in two or more thicknesses each of which is made up of two plates with a longitudinal joint on the center line covered with inside and outside shop-riveted full-length splice plates. The web plates are all full width, double, and shop-riveted together before the members are assembled. The outside web plates are 1 1/16 in. thick, the other principal plates are from ¾ in. to 1 in. thick. are cut at 45 degrees to clear the main post angles four of them ¾ in. thick and the remainder 1 in. thick.

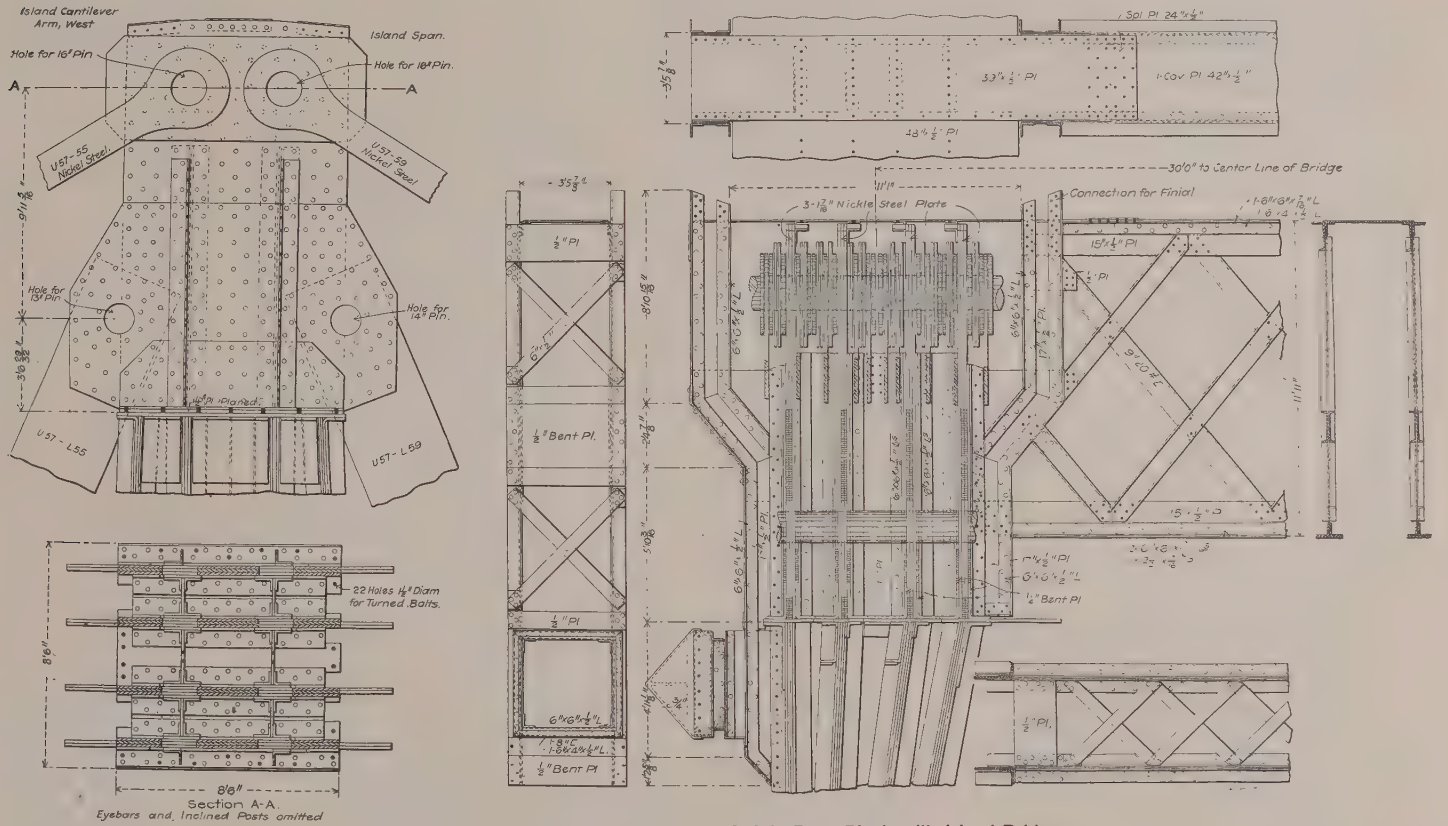
In each section of the post the webs are connected by sets of ½ in. horizontal transverse diaphragm plates about 6 or 8 ft. apart with 4 x 3½-in. connection angles. The corners of the diaphragms are cut at 45 degrees to clear the main post angles and each plate has a manhole in the center to afford passage through the interior from end to end. Manholes are also provided in the main web plates connecting the center and side divisions of the posts. Each splice is made with 20 vertical plates from ⅝ in. to 1 1/16 in. thick and from 6 ft. to 8 ft. 8 in. in length, and four 7 x 7 x ⅝-in. cover angles cut from 8 x 8-in. angles. Sheared edges of all materials over ⅝-in. thick are planed ¼ in.; in materials up to ⅝-in. thick all rivet holes are punched full size, in materials from 11/16 in. to ⅞ in. thick, inclusive, rivet holes are sub-punched and reamed ¼ in. or are drilled from the solid, and in all thicker materials all rivet holes are drilled full size from the solid. Nearly all rivets are 1 in. in diameter. The ends of all sections are faced.

The lower end of the lower section of the post is bevelled 39:384 to correspond with the batter and engage the horizontal top of the upper pedestal casting. A 72 x 1½ x 105-in. base plate is riveted to it through wide bent plates and 8 x 8-in. angles 1 in. thick, and it is stiffened and the distribution of pressure is promoted by a 1-in. vertical center diaphragm plate about 7 ft. high transverse to the main webs. The base plate is countersunk riveted to the post, and is connected to the pedestal by 64 2-in. turned bolts in holes drilled to the same template for both members. About 10 ft. above the base of the post there is in one of the cover plates a 14 x 30-in. entrance manhole with a bolted cover plate. The cross sectional area of the post lost by cutting this manhole is, like that lost in all other manholes, restored by riveting reinforcement plates on both sides of it. The manholes through the horizontal diaphragms between the center webs are made larger than those between the outer and center webs, and a light steel ladder is carried through them and fastened to short horizontal angles at every diaphragm, thus providing for interior inspection.

The intermediate sections of the posts are substantially like the lower section except for the varying transverse width, but the upper sections are special and are flared out to a greater width at the top to receive the shoe which provides connections for the top chord eyebars in the island and cantilever spans. Two very heavy vertical diaphragms, transverse to the main webs, are riveted into the top of the section and stiffen it and support the 121 x 1½ x 104-in. cap plate which overhangs the post on the side towards the center of the bridge to afford connection for the top transverse strut which has bearing against its planed horizontal edge.

The shoe at the top of the post provides connections for the inclined top chord eyebars and for the diagonal posts with separate pins for each member. It is essentially a flange-connected extension of the post with four thick, reinforced webs connected by two transverse diaphragms. It weighs about 65 tons and its dimensions are the maximum that can be shipped from the bridge shop to the site. Its 1½-in. base plate is planed top and bottom and is connected to the post cap by 22 1½ in. turned bolts and four 3-in. anchor bolts, the latter engaging horizontal bearings on the diaphragms which connect the main webs.

Pairs of single vertical angles on the outer webs of the shoes provide for field-riveted connections to the end web tie plates of the double lattice girder transverse struts at the tops of the pier bents. The top flanges of each pair of girders are connected by a shop-riveted cover plate and the bottom flanges are latticed together, thus uniting them in a single compression member of rectangular cross section with open sides and bottom. The top flange cover plate extends across the top of the shoe and is field-riveted to short connection angles on the webs of the latter. Side plates are riveted to this cover plate and with it form a complete cap for the shoe which is assembled after the eyebars there have been erected and the connection angles field-riveted to the webs. A vertical, flanged side plate, bent and offset to clear the eyebars and corresponding exactly to the end of the transverse strut is field-riveted to the outer web of each shoe and extends below the connection of the latter to the post cap, thus providing a symmetrical outline for the top of the bent and affording connection, near its foot, for a pyramidal cast-iron cap projecting horizontally 4½ ft. from the face of the post to relieve the structural line. The offset bent vertical angles on both sides of



Section A-A. Eyebars and Inclined Posts omitted

Eyebar Shoe and Connections at Top of Main Post, Blackwell's Island Bridge.

the shoe have projecting upper ends with field rivet holes for the connections of a balcony, canopy and architectural finial which will surmount the post and will be accessible to visitors by a steel stairway ascending the transverse diagonals between the main posts to the center of the upper transverse strut which will also act as a bridge connecting the post tops.

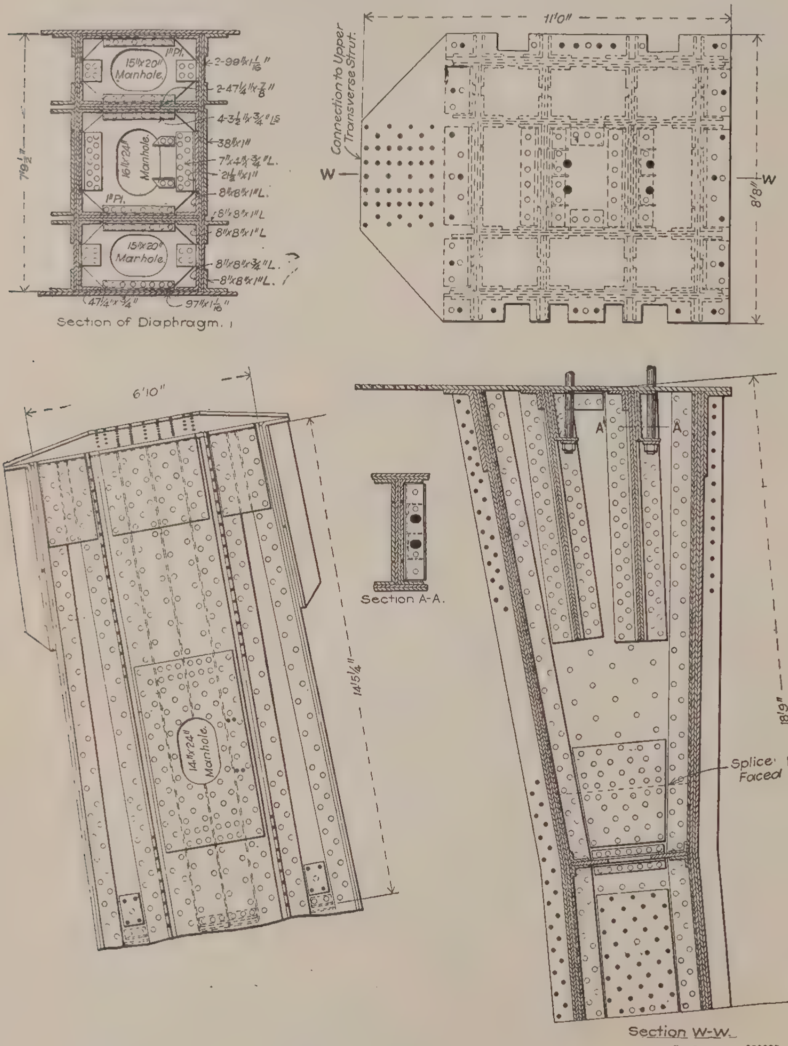
At the center of the upper transverse strut there are a pair of vertical webs in the planes of the twin girders, which are attached to the lower flange and serve as bolsters or fillers connecting this strut to the second transverse strut. The latter is a compound member with the outline indicated on the general elevation diagram of the pier bent and consisting of top and bottom members connected by vertical and diagonal pieces. The top part is a box plate girder with a closed rectangular cross section horizontal bottom flange and inclined top flange. It is about 3½ ft. wide and 6 ft. deep at the center and is made with ½-in. web plates, 6 x 8 x 1-in. flange angles, turned inwards, and has a 40 x 1½-in. top flange cover plate. The outsides of the webs are paneled by bulb angles. The lower inclined girders slope from the center of the box girder to the main posts to which they are connected by extended web plates curved tangent with both members. The inclined girders are like stiff lower chord sections and have two 30 x ½-in. webs and four 6 x 6 x ¾-in. angles with tie plates and lattice bars on the top and bottom flanges, respectively. The web members connecting the top and bottom girders have rectangular cross sections and are made with pairs of 9 to 12-in. channels latticed, with their webs field-riveted to gusset plates engaging the girder flanges. Both top and bottom girders are field spliced in the center.

The vertical members between the top and bottom struts in the pier bents are made with pairs of built channels having their inner and outer flanges connected by tie plates and lattice bars, respectively. Each channel is made with a 36 x ½-in. web plate and two 6 x 6 ½-in. flange angles. The outer flange angles are reinforced in some places by 12 x 7/16-in. plates which project inside the webs and receive there the lattice bars which do not engage the angles. Gusset plates are riveted to the webs to receive the zig-zag members which connect the verticals with the main posts except at the upper ends where the webs project beyond the flanges of the built channels and are riveted between vertical angles on the faces of the posts. The zig-zag members are made with pairs of built channels from 16 to 24 in. deep with their flanges connected by tie plates. The main diagonals between the verticals in the pier bents have 24 x 40-in. rectangular cross sections made with built channels with their flanges turned inwards and latticed by 4-in. channels. They are built with 24 x ½-in. web plates and 6 x 4 x ½-in. flange angles, and at the intersections in the centers of the panels are cut to double mitered joints and spliced by large curved plates field-riveted connection plates in the planes of the webs.

The bottom horizontal transverse strut connecting the feet of the vertical members and the tops of the lower inclined members is a lattice girder extending through these members to the main posts. The diagonals are double mitered at the intersections in the centers of the panels, all their webs are in the same vertical planes and are shop rivted to rectangular connection plates, thus making rigid X-shape panels of complete bracing field riveted at the ends of the members to the gusset connection plates.

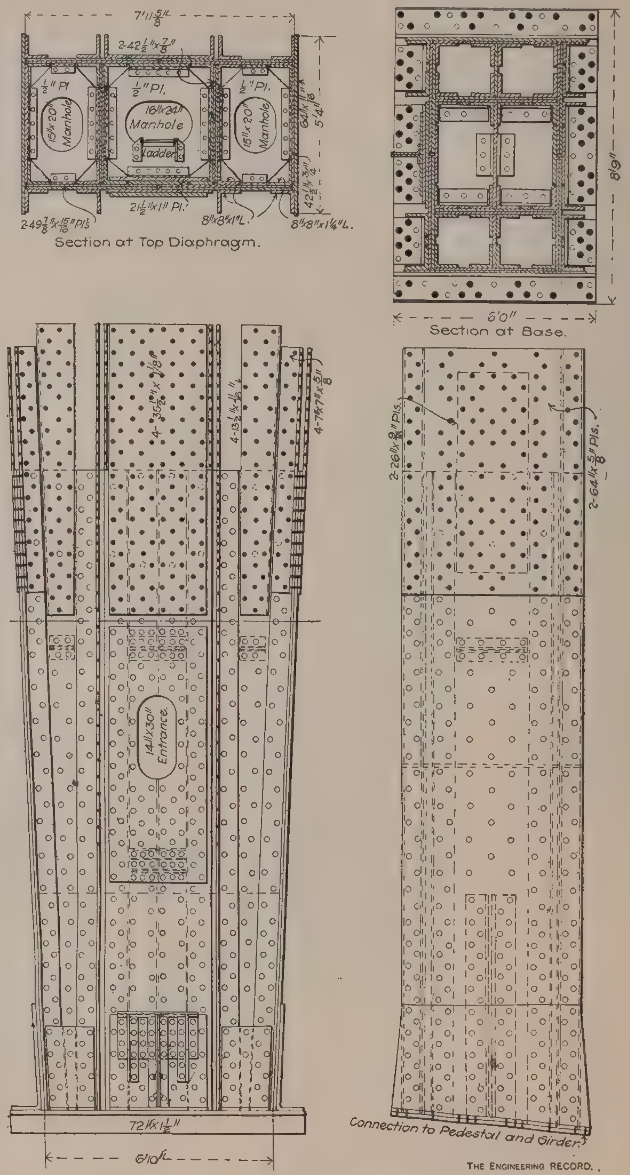
All connections between chords and web members are field riveted and the truss members will be shipped separate from the shops and assembled together at the site. The pier bent will be assembled up to and including the second floor system at one operation and the upper part will be assembled by the second operation of erection by the No. 2 travelers described in The Engineering Record of March 18.

(To be continued.)



The Engineering Record

Upper Section of Main Post.



The Engineering Record.

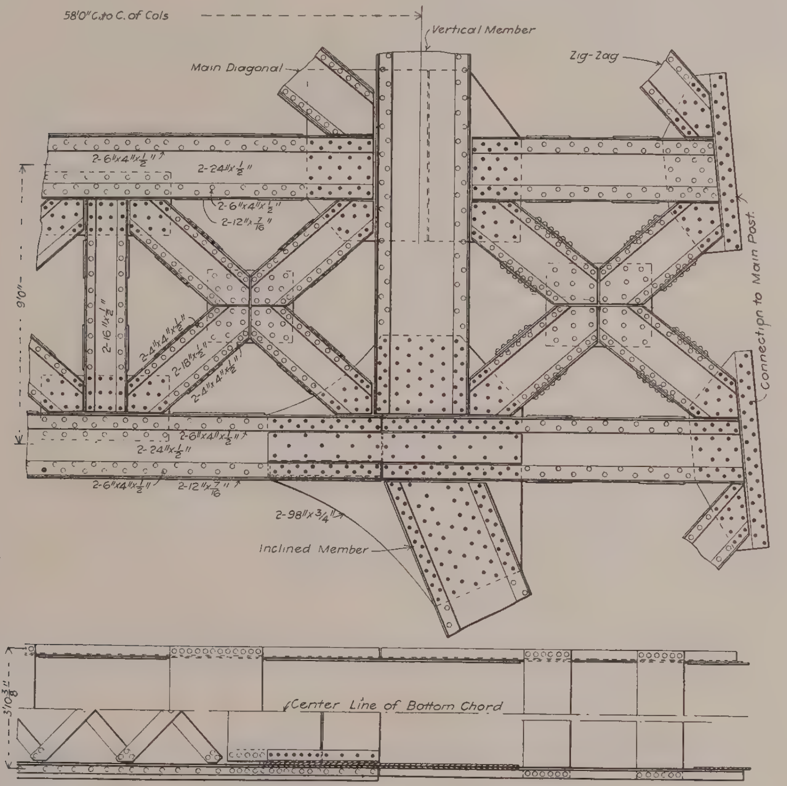
Lower Section of Main Post.

An Experiment in Forestry has been undertaken by a large paper mill company in New York State. A 20,000-acre tract is to be set out with Norway spruce seedlings, 650,000 of which have already been imported from Germany.

The Cleaning of Blast Furnace Gas.

A paper read before the Iron and Steel Institute by Axel Sahlin, London.

The rapid development of the gas motor during the last five years has given new value and importance to the gas escaping from the blast furnace, previously often described as waste gas. This "waste gas" has now become a potential source of energy, which, rightly used and husbanded, should, together with the gas from the coke ovens supplying the blast furnaces, suffice for the carrying out of the entire series of converting and finishing processes which transform the ore into marketable steel products. The gas leaving the blast furnace carries with it a varying amount of gritty dust, which has proved a more serious obstacle to the successful operation of large gas engines than any mechanical imperfection in the construction of these engines. Successful efforts to remove the dust from the gas used in the gas engine have in a practical manner demonstrated how wasteful and imperfect have been our previous methods of utilizing the valuable blast furnace gas.



Lower Transverse Strut, Blackwell's Island Bridge.

Until the appearance of the gas engine at the blast furnace plant the dust problem was, as a general rule, dealt with in a different manner by each of the three large iron producing countries. In England, in at least 90 per cent. of the blast furnace works, the dust in the gas was disregarded. A single downcomer carried the gas escaping from the tunnel head into an underground gas flue leading to stoves and boilers. In this flue and in the stoves and boilers the bulk of the dust was deposited. Every few months a rather long stoppage, regularly attended by subsequent more or less costly disturbances of operation, was required for the cleaning of these flues, while the cleaning of stoves and boilers belonged to the daily routine of the works. English engineers were in a position to ignore the dust problem, partly because of the customary slow driving and partly because of the clean and firm structure of the materials used. But even with these advantages stoves, and especially boilers, had often to be put out of operation, cooled down and cleaned, and the efficiency of the plant suffered.

In Germany, the majority of the furnaces were equipped with a dry or wet dust catcher, consisting of a series of upright tubes of small diameter, the open bottoms of which extended downward into a common water seal. The dust was deposited mostly by centrifugal force, as the direction of the flow of the gas was suddenly changed in passing through the cross tubes connecting one chamber with the other. Usually six of these chambers from 6 to 8 ft. in diameter, and often 60 ft. in height, constituted the dust catcher. The collected dust was raked from the pan forming the water seal by manual labor. The gas leaving the dust catcher could not be considered properly cleaned.

Since the discovery of the Mesaba mines American blast furnace engineers have been compelled to use a burden containing from 50 to 100 per cent. of dust fine ore, and the question of cleaning the gas became of imperative importance. The generally adopted American dust catcher consists of a wide, unobstructed chamber, through which the gas passes and in which its velocity is greatly retarded. The bottom of the dust catcher is built as a hopper, closed at its lowest point by a door or valve through which the dust from time to time is removed by gravity. It required the appearance of the gas engine to compel improvements in these methods and to stop, at least partly, the waste which had been permitted to go on from year to year.

We have now learned and realize that the whole of the gas escaping from the blast furnace should be utilized for subsequent refining and finishing processes and that before being so used it should be thoroughly cleaned. By cleaning all the gas we could save one stove per furnace. (No reserve will thenceforth be necessary to maintain the capacity of the furnace during the periods of cleaning of the different stoves, and three stoves per furnace will give good practice.) The heating surface of the three remaining stoves may be made 10 per cent. smaller than hitherto, because with dusty gas the value of the heating surface will gradually decrease whereas with clean gas it will have a permanent efficiency. The heating surface of the boiler plant may be reduced from 10 to 15 per cent. for the same reason and because the necessity for periodical cleaning of the boiler settings will disappear. The repairs to the boiler plant will be reduced as the strains due to frequent cooling of the boilers are avoided. The labor force previously constantly employed in cleaning stoves and boilers may be dispensed with. The more perfect combustion will reduce gas consumption and liberate for use in other departments a considerable percentage of gas hitherto wasted. The percentage of gas thus saved may be estimated at about 20 per cent. of the volume burned in stoves and boilers. The success of blast furnace operations depends entirely on the regularity and uniformity of conditions affecting the furnace. Uniform fuel gas will give uniform heat and uniform power and will add increased efficiency to the furnace.

Granting then that blast furnace gas should be cleaned before being burned we proceed to conduct the process of cleaning from two points of view—the degree of purity reached and the cost of reaching it. It is the removal of the last fraction of a gram of dust contained in a cubic meter of gas which largely adds to the expense of cleaning. For stoves, boilers, kilns, furnaces, etc., such a small quantity of exceedingly fine and buoyant dust is no detriment, as it will pass off with the products of combustion through the smokestacks. A gas containing 0.3 gram per cubic millimeter or less is sufficiently clean for these purposes. For the gas engine, on the other hand, the gas can never be too pure, and the removal of the last tenth of a gram, though expensive, will pay for itself in longer life and decreased repairs to the expensive engines.

The cleaning of the blast furnace gas should take place in three stages, as follows: The preliminary dry cleaning, which does not involve extra operating expenditures; the wet cleaning, to fit the entire quantity of gas for use in stoves and under boilers, in roasting kilns, furnaces, etc.; the special cleaning for purifying part of the gas for power purposes.

Dry Cleaning.—The gas should be removed from the blast furnace as much as possible symmetrically around the circumference of the furnace, so as to avoid an excessive flow of gas in any one direction. The use of four gas uptakes, which curving downward, should unite into one main downcomer, is to be recommended; this downcomer to enter the dust catcher tangentially and near the bottom of the chamber. It is a mistake, from the point of view of cleaning, to make the downcomer too wide. It should be designed so as to cause the gas to flow with an average velocity of from 25 to 35 ft. per second. The dust catcher should be built in the shape of a vertical cylinder with conical top and bottom; it should have a diameter of not less than four times that of the downcomer. The delivery opening from the dust catcher should be placed centrally at the top of the same. The gas will by this arrangement, on entering the dust catcher, be given a rapid swirling motion, and the two powerful and inexpensive agents, gravity and centrifugal force, will combine to deposit in the dust catcher all the heavier particles of dust. According to the nature of the materials charged the dry dust thus collected may or may not be worth briquetting and recharging.

The gas leaving a well-designed dust catcher may still contain from 2 to 8 grams of dust per cubic meter, depending largely on the character of the ore employed and the rate of driving of the furnace.

The whole volume of gas should next be submitted to the second stage of the cleaning process.

Wet Cleaning.—The second cleaning should be effected by means of water. Experience has proved that the fine dust settles most readily on cool and moist surfaces. The passage of gas through open chambers, even though profusely sprayed with water, has not proved effective.

Inventive effort has during the past five years been directed toward providing gas cleaning apparatus, which may be grouped into three classes: Stationary cleaners, or scrubbers; rapidly revolving or atomizing machines, and slowly revolving or fresh contact cleaners.

Stationary Cleaners.—These consist of chambers, from the top of which sprays of water, distributed over the entire section of the chamber, descend. The water is arrested by a number of grids or porous masses of material with numerous interstices. Iron bars—rolled and cast—tangled wire, coke or wooden slats, have all been used with success as filling material or grids. The gas enters the apparatus from below the grids and ascends, meeting the sprays of water falling from above through the innumerable interstices in the obstructing grids or masses, to the wet surfaces of which the dust adheres, only to be washed away by the falling drops of water. The Zschocke cleaner is a well designed type of such apparatus. It is claimed that the gas leaves this apparatus with from 3.0 to 1.4 grams of dust per cubic meter.

Rapidly Revolving Machines.—The earliest form of the rapidly revolving or atomizing apparatus was, as a matter of course, the fan. Having been in use for generations, it was at once available as a mechanically perfect tool. The water injected into the fan, together with the gas, was forcibly dashed against the casing, removing the dust. A modification of the fan is the Theisen apparatus, which provides a forced contact between gas and spraying water driven against a cylindrical envelope by fan blades set at oblique angles to the axis of rotation. There are probably no more effective contrivances known to-day for elimination of the blast fractions of a gram of dust per cubic meter than a properly designed and rapidly revolving fan or a Theisen apparatus. But the good work is not done cheaply, as the power consumed for revolving the blades increases greatly when the water sprays are put in operation. This class of apparatus is, therefore, most suitable for thoroughly cleaning the portion of gas used for generating power.

Slowly Revolving Apparatus.—The considerable power required to drive rapidly revolving water sprayed fans on the one hand, and the difficulty of insuring a thorough and uniform cleaning on the grids or checkers of the stationary apparatus on the other hand, led to the design of slowing revolving gas cleaners, which are particularly suited for the second, or wet cleaning of the entire volume of gas produced by the furnace before it is admitted to the stoves, boilers, kilns or to the fan which finally prepare it for the gas engines.

The Bian apparatus is the earliest form of this type and has proved very effective. It consists of a horizontal cylindrical casing, through which the gas is passed from end to end. In the axis of the cylinder revolves slowly a shaft, to which are bolted a number of circular disks of perforated plates of a diameter but little less than the inside diameter of the casing. The gas is therefore in its progress compelled to pass through the perforations in the disks. Between the perforated disks extend from the outer envelope annular deflecting plates, which compel the gas to approaach the center of the apparatus after each passage through the perforations in the revolving disks. The outer shell is filled with water up to the bottom of the central shaft. In revolving the perforations in the disks are therefore dipped into water and thoroughly washed for every revolution of the apparatus, and ascend from the bath covered with thin films of water. The dust which settles on the bottom of the apparatus is from time to time drained off through suitable sludge valves. This apparatus is effective and requires but little power to slowly revolve the central shaft and the disks fastened thereon.

With the view of securing larger capacity of each apparatus—that is, a larger area of perforations in proportion to the diameter of the apparatus—a better and more continuous wetting of the perforated surfaces and a more automatic and constant removal of the dust—my firm has designed a new style of slowly rotating gas cleaning apparatus, which has been named the Sahlin revolving gas cleaner.

It consists, like the Bian apparatus, of a horizontal cylindrical shell. Parallel with the axis of this shell, but somewhat below the center of the same, is placed a horizontal shaft. On this shaft are fitted, alternately, spider arms supporting rings of double 3-in. angle iron riveted together and solid plate disks carrying at their circumference similar angle rings. Between the angles of the spider arms and those of the disks are bolted perforated plates, forming the envelope of a drum. The oblong perforations are wider at the end of the cylinder where the gas enters and gradually narrower toward the discharge end. Between the outer shell and the inner revolving drum is formed a horseshoe shaped space, widest at the top. Closely behind the rim of each spider this space is divided by plate diaphragms riveted to the outer shell and practically closing the open area between shell and drum. To the angle rings of the frame, supported by the spider arms and by the disks, are bolted a series of spirally bent flat bars, or scrapers, which closely approach the bottom of the shell. Near the gas inlet is riveted, to the lower part of the shell, a water sealed discharge opening. At the bottom of the shell, near the gas entrance, a drain cock or sludge valve is provided for emptying the apparatus. Along the top of the shell three rows of sprinklers are arranged, so as to deluge the entire top of the revolving perforated plates with a dense spray of water. The drum is turned by worm and worm gear through a belt pulley driven from the ventilator described below.

When the gas enters the apparatus through the head of the outer shell it is admitted into the drum between the spider arms supporting the first angle iron ring, but is then confronted by the first solid disk. The only passage offered is through the narrow and dripping perforations of the drum. In passing these the gas is met by the profuse spray from the sprinklers. It is at the same time spread out into a thin sheet in the horseshoe shaped space between the two cylinders and advances outside and beyond the first revolving disk until met by the first horseshoe shaped diaphragm, which prevents further progress and compels the gas again to enter the interior of the drum beyond the first disk. Passing through the openings in the second spider wheel, it is again compelled to flow outward through the perforations in front of the second disk, and so on, the gas passing forward and back through the perforated envelope, now spreading itself into a thin layer, now contracting itself into a cylindrical column, and continuously exposed to the intense spray from the sprinklers. The gas has, of course, to turn an angle of 180 deg. every time it passes through the perforations. It is finally delivered through the discharge opening, which corresponds to the opening of admission, at the opposite end of the shell. The dust is settled in the water at the bottom of the shell and is moved by the spirally bent scrapers toward the inlet end, where it is discharged automatically through the water sealed overflow.

As the areas of drum, perforations and horseshoe shaped space are all very large compared with the section of the downcomer, the velocity of the gas in passing through the apparatus is greatly reduced. The resistance offered by the apparatus is, therefore, insignificant, even though the entire volume of gas produced by one furnace is passed through a single apparatus. The perforated drum is revolved about six reversions per minute, requiring less than 1½ h. p., which power is transmitted by a belt from the shaft of the ventilator. It has been found that whether a stationary or slowly revolving apparatus is used for the second cleaning, the tunnel head pressure must be assisted by a ventilator to insure an even flow of gas. This ventilator is, however, by no means as great a consumer of power as would be water sprayed cleaning fans or atomizers. A ventilator passing 40,000 cubic feet of gas per minute (equal to about 70,000 cubic meters per hour) against a head of 2 in. water column requires only about 35 h. p.

Safety Device.—If for any reason, such as the hanging of the furnace or the sudden stoppage of the blowing engine, the flow of gas from the furnace should cease or be reduced, there is with all forms of gas cleaning apparatus a danger that air may be drawn into the apparatus and gas tubes, where the mixture of gases formed may, in unfavorable circumstances, cause serious explosions. To prevent the possibility of this I recommend a very simple and effective device, consisting of a small gasometer having a diameter of 8 ft. with a lift of 6 in. This gasometer is so balanced that it will drop when the pressure inside the piping falls to ¼-in. water column. The interior of the gasometer is connected by a pipe with the dry dust catcher. An arm projecting from the top of the gasometer connects with a switch in the circuit, carrying the electric current to the motor driving the ventilator and cleaner in such manner that when the gasometer drops the current is broken and the motor stopped. When the returning pressure in the dust catcher causes the gasometer to rise the circuit is automatically closed and the cleaning apparatus started.

In a cleaning plant for the entire volume of gas from one blast furnace, the gas leaves the furnace through four uptakes placed at an angle of 90 deg. These join into one downcomer, which delivers the gas in tangential direction into a cylindrical dust catcher. From the top of the dust catcher the gas passes through one of two mushroom valves. The valve nearest to the stoves connects the dust catcher direct with the gas main and is opened only in case of repairs to the gas cleaning plant. The second valve connects the dust catcher with a water seal, from which the gas flows into the Sahlin gas cleaner described above. From this gas cleaner it reaches a ventilator, which delivers the now sufficiently clean and cooled gas into the bottom of a dryer. By closing the drain pipe and admitting water this scrubber may be changed into a second water seal, effectively isolating the cleaner. Crossbars inside the dryer carry a column of coarse coke. In passing through this the gas is freed from the bulk of the water which may be mechanically carried from the second or wet cleaning. At the top of the dryer a mushroom valve again admits the gas into the general gas main. There is no spare or reserve provided for this simple wet gas cleaning plant. The damage caused by occasionally using for short periods gas direct from the dust catcher, as now is being done continuously, is not sufficient to justify an increased investment in duplicating the plant. The power required for the second stage of cleaning of 40,000 cu. ft. of gas of a temperature of 20 deg. C. is, as above stated, 36½ h.-p., to which must be added 8 h.-p. for pumping cooling water.

Gas for the Power Plant.—This is drawn from the clean gas main and is passed through one of two electrically driven fans sprayed with water and discharged into a second smaller dryer, whence the gas, now dust free, practically speaking, is sent to the engines. The size of this plant depends on the quantity of gas required for power purposes. A fan cleaning 10,000 cu. ft. per minute and using 8,000 gal. of spraying water per hour requires about 65 h.-p. and will supply gas engines of from 5,000 to 6,000 h.-p. The pumping of spraying water will require about 3 h.-p. additional. The cooling water used in the cleaning processes is delivered into double settling and cooling ponds and is thence lifted by centrifugal pumps into a standpipe or water tank, from which it is returned by gravity to the cooling plant. On top of the tank may be arranged trays for additional cooling of the water.

The secondary cleaning plant, slightly modified, may be attached to any existing gas main. A slide valve is inserted into the gas main, and on either side of this valve is placed, on top of the main, a mushroom valve. The mushroom valve on the side nearest the furnace will connect directly with the water seal and the Sahlin gas cleaner. The mushroom valve on the side away from the furnace will return the gas directly from the dryer into the existing gas main. Should it be necessary to stop the gas cleaning plant, the slide valve is lifted and the mushroom valves are closed, the gas, according to present general practice, passing directly from the dry dust catcher to stoves and boilers or to the special cleaning plant for the gas engines. Interruptions in the working of the secondary cleaning plant will, however, be infrequent, as the simplicity and solid construction of the plant will reduce repairs to a minimum.

Structural Features of Rockefeller Building at Cleveland.

The J. D. Rockefeller Building, at the corner of Superior and Bank streets, Cleveland, occupies a lot about 126 ft. square and is a 17-story steel cage, fireproof modern office building. The rear half of the site was excavated to a maximum depth of about 33 ft. and the sides of the pit are enclosed with concrete retaining walls carrying the brick basement walls and having a maximum thickness of 5 ft. at the base. These walls are of special design, reinforced with steel bars and No. 10 expanded metal with 3-in. mesh in horizontal sheets. The inner faces of the walls are vertical and the outer faces are offset with one or two steps. The walls are stiffened with buttresses from 2 ft. to 3 ft. thick and from 8 ft. to 14 ft. apart. These are reinforced with flat bars from 3 in. to 6 in. wide, twisted at the upper ends which are bent to hook over top bearing beams in the wall and split and bent to form T-heads at the lower ends where they pass through between the webs of the horizontal I-beams in the footing.

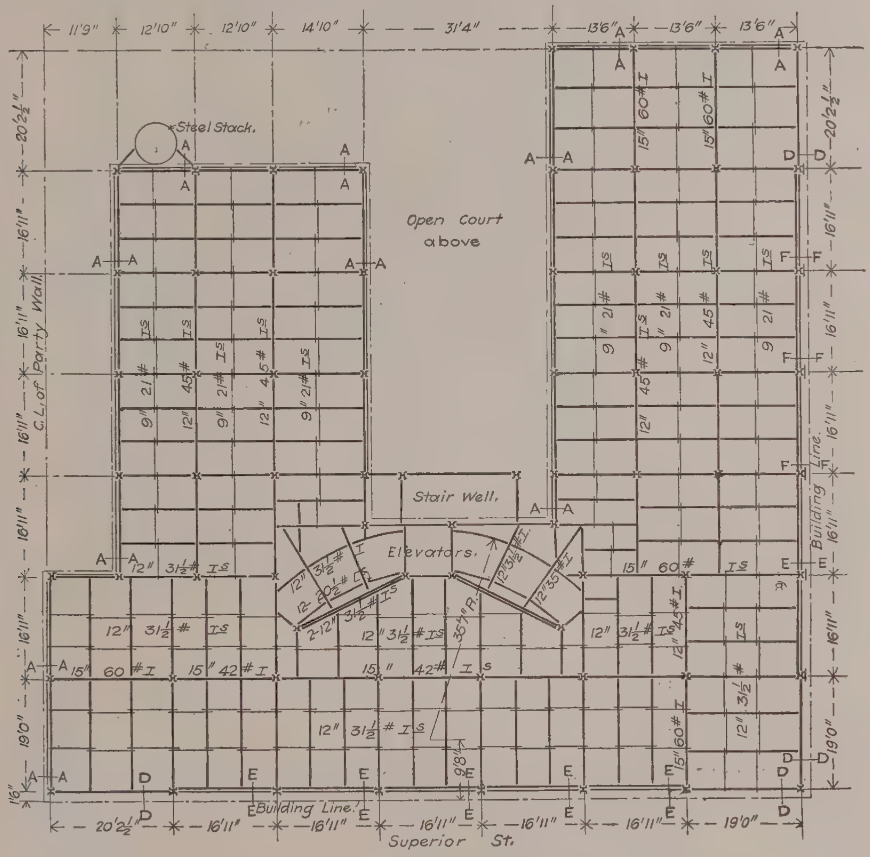


Diagram of 5th and 6th Floors, Typical of Upper Floors.

The footings are of concrete reinforced with horizontal beams made integral with the wall and buttresses and extending from 4 ft. to 9 ft. from the inner face of the wall in the planes of the buttresses. The reinforcing I-beams are embedded in the concrete and serve as cantilevers to resist any overturning tendency from the pressure on the outer faces of the walls.

The columns have cast-iron pedestals seated on groups of transverse distributing I-beams up to 24 in. deep which transmit the loads to grillage beams from 12-in. to 18-in. deep bedded in the concrete rectangular piers. The concrete is continued around the distributing girders and the pedestals to completely seal them and the excavation is back-filled around the piers up to subgrade for the concrete cellar floor. Most of the columns have separate piers but in some cases when piers would otherwise overlap two columns have one pier.

The smokestack has a height of 242 ft. 9 in. above the bottom of its footing, and is made with a 6 ft. 10-in. steel shell. The thickness of the shell is 7/16-in. in the lower quarter, ⅜-in. in the second quarter and 5/16-in. in the upper half. Inside horizontal angle rings are riveted to it 12 ft. apart vertically to support the fire-brick lining 4½ in. thick and ½ in. clear of the shell which extends from 8 ft. below the breeching to 90 ft. above it. The base of the steel shell is bolted to a flanged octagonal cast-iron base ring with a Z-shape cross section. This rests directly on, and is bolted to, and made integral with the footing nearly 19 ft. square, in which there is embedded a double grillage of crossed I-beams 12 in. deep. All concrete in the walls, piers and stack is made with Lehigh Portland cement 1:4:4, made with 2-in. broken stone and mixed in a McKelvey concrete mixing machine.

With the exception of a 20-ft. x 54-ft. light court at one corner the superstructure occupies the entire area of the lot up to the second floor, above which there is a 28-ft x 50-ft. open court in the rear, giving light and air to the two side wings. There are 68 principal columns, arranged in the main part at the intersections of eight longitudinal and eight transverse lines 16 ft. 11 in. apart, except at the corners, where they are 19 ft. and 20 ft. 2½ in. apart. This gives most of the floor beams and girders a clear length of about 16 ft. and permits a simple and regular arrangement and economical proportions. Except in the center of the building, where special framing is required around the elevator wells, the front part of the building has 15-in. girders and 12-in. floor beams, the latter a little more than 5 ft. apart and carrying the hollow tile flat floor arches proportioned for a combined live and dead load of 167 lb. per sq. ft.

In the wings the columns are spaced closer together, transversely, aand the dimensions of the beams and girders are reduced to 9 and 12 in., respectively. All regular beams and girders are connected to the columns on the center lines, except where variations are made at the wall columns and for the elevator well framing. The light brick walls are carried at every story by the wall columns, and in most cases they rest on beams or girders entirely separate from those which carry the floor. Deep plate girders are, however, introduced between the wall columns at all corners of the building to provide wind bracing, these girders being calculated to also carry both floor and wall loads. The general arrangement of beams and girders and their principal sizes are shown in the plan of the fifth and sixth tiers, and the other tiers above the second floor are substantially the same except the roof which is lighter.

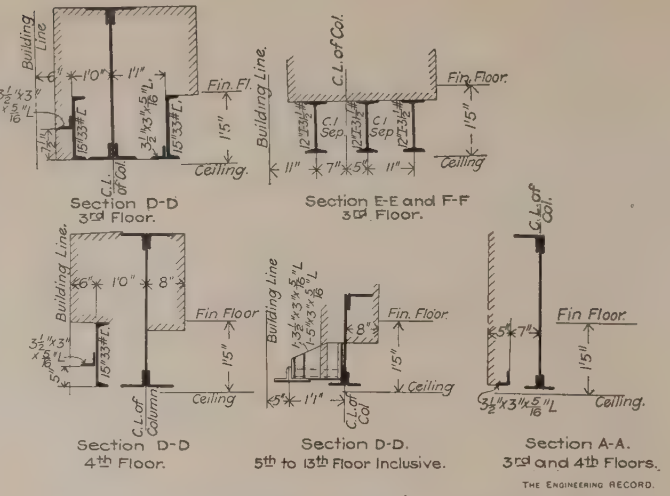
The walls are carried directly on the beams and girders which are bedded solidly in the masonry, and on horizontal angles riveted to their webs to give increased supporting area: in some cases light masonry under window seats is carried on T-shape spandrels made with a pair of horizontal angles back to back, as in section D-D, which are supported by solid-web brackets from the girder webs. The arrangement of the wall girders and spandrels varies in different panels and in different stories to correspond to the architectural requirements, but nearly all cases correspond substantially to the typical sections shown.

At the second floor level the space between the rear wings is enclosed by a deck or roof over the first story, framed as indicated by the diagrams of plan and elevations. The construction is a flat platform like an ordinary roof or floor supported on the regular beams and girders in the wall columns of the court walls of the wings. At the inner end of the court there is a stairway with a raised roof with its transverse beams carried on light longitudinal trusses which raise them to the required height.

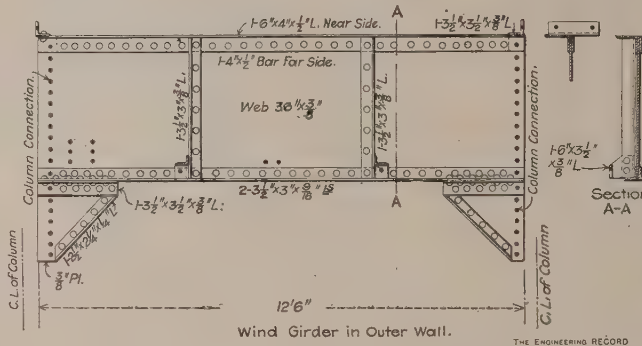
All columns are of very simple construction and are of the standard H-shape cross section made with a maximum section composed of four Z-bars, a web plate and two or more flange plates. In the upper part of the building the sectional areas are reduced by diminishing the thicknesses of the metal and omitting flange plates, but the sizes of bars and outside dimensions of the columns are not otherwise changed. All of them are made in two-story lengths with joints uniformly 2½ ft. above finished floor level. The splices are made without horizontal diaphragms or flanges, and have simply flange cover plates shop riveted to the upper ends of the column section to make jaws and field riveted to the lower ends of the adjacent sections. All I-beam connections are made with angle brackets, shelves and web-connection angles on the beam.

The wall girders at the corner columns are web-connected with field rivets through vertical angles shop riveted to the faces of the columns. In some cases their lower flanges are seated on horizontal bracket angles as shown in the column detail, and in others they have solid-web knee-brace brackets shop riveted to the girder and field riveted to the column. The bottom flanges of these wind girders are made with a pair of angles back to back, but the top flanges are made with a single 6 x 4-in. outside angle and a 4-in. flat bar riveted to the opposite side of the web and cut at the ends to clear the column connections. The girders are divided into short panels by vertical web-stiffener angles and fillers.

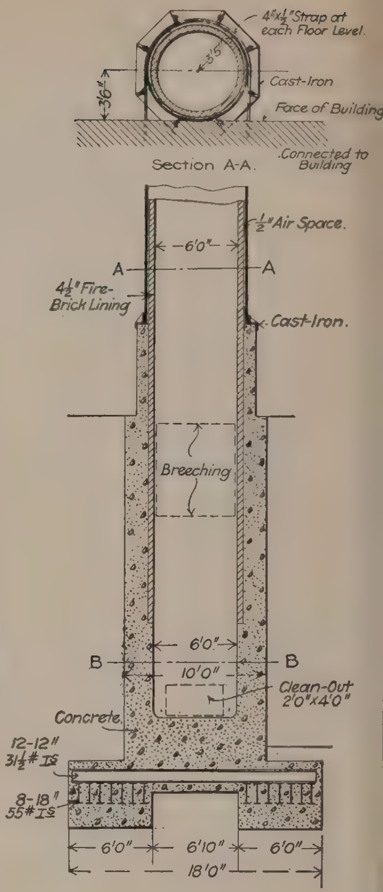
The steel framework was erected by two stiff-leg derricks with long booms operated by hoisting engines stationary on the first floor. The derrick

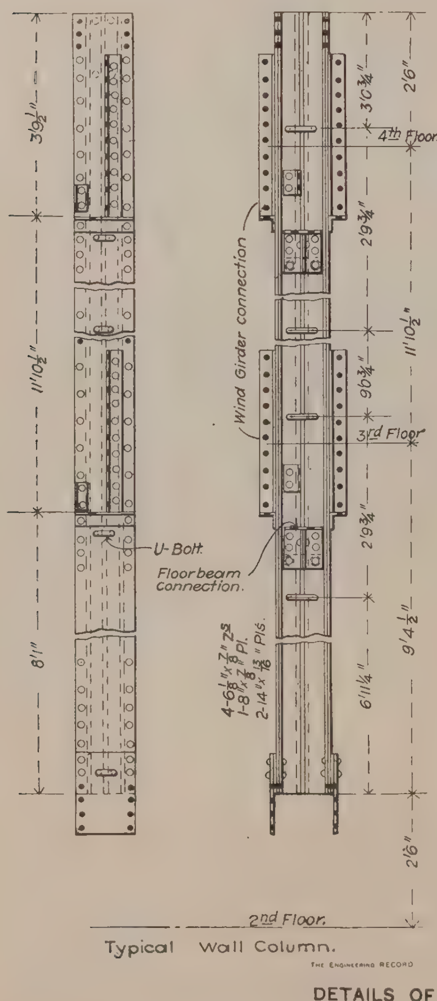


Section D-D 3rd Floor. Section E-E and F-F 3rd Floor. Section D-D 4th Floor. Section D-D. 5th to 13th Floor Inclusive. Section A-A. 3rd and 4th Floors.

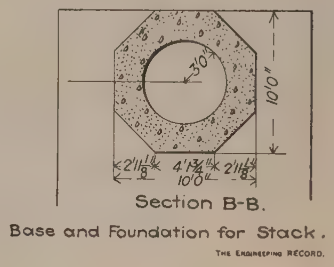


Wind Girder in Outer Wall.



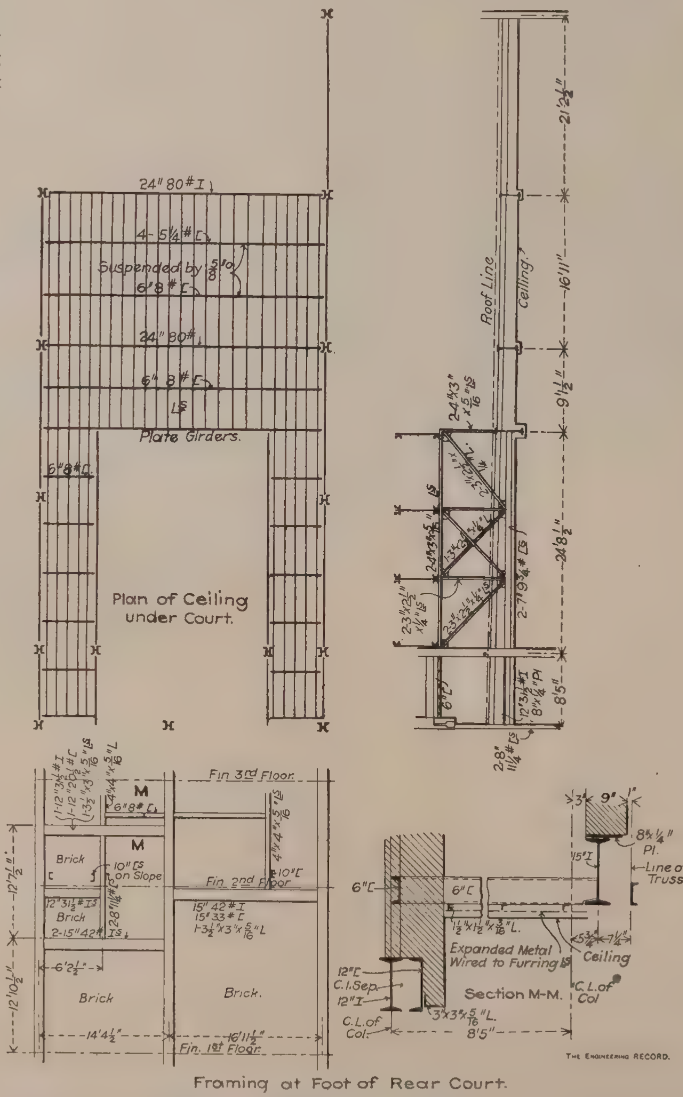


Typical Wall Column.

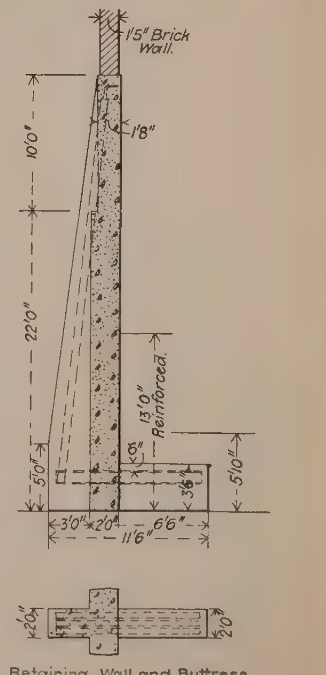


Section B-B.

Base and Foundation for Stack.



Framing at Foot of Rear Court.



Retaining Wall and Buttress.

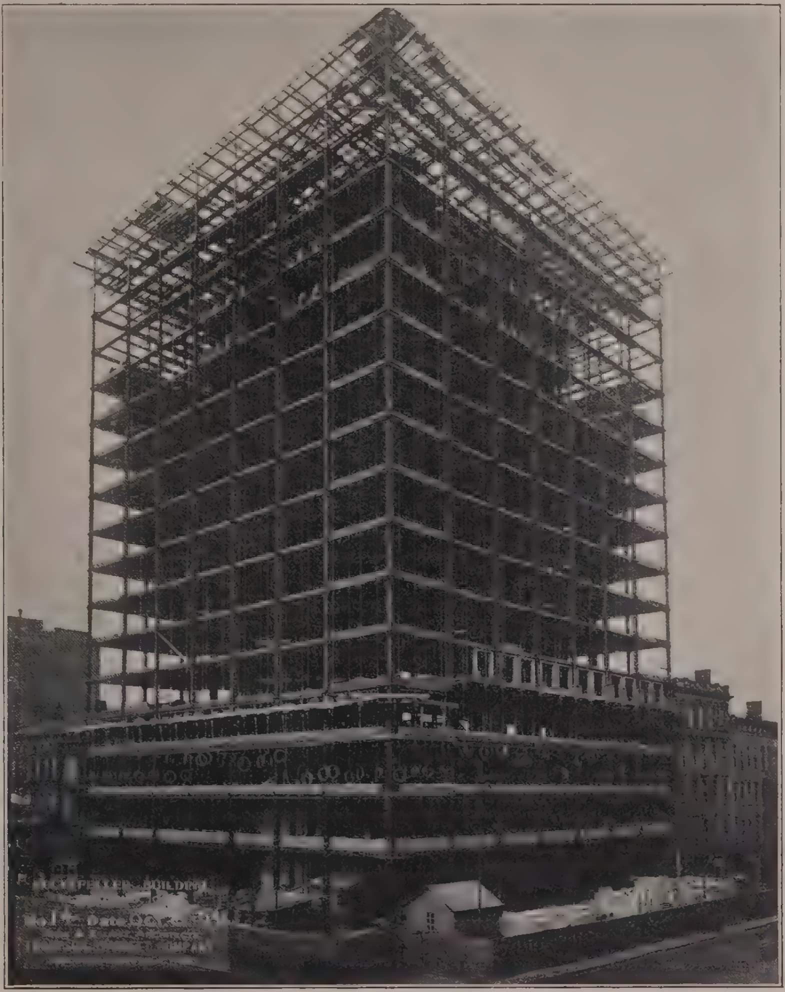
DETAILS OF STEEL AND CONCRETE CONSTRUCTION, ROCKEFELLER BUILDING.

frames were made with a T-shape horizontal timber frame clamped to the beams and girders in the last tier set. Two inclined posts in the plane of the sills forming a tripod to the apex of which the topping lift tackle was attached and operated a boom much longer than the height of the tripod. The derricks commanded nearly the whole area of the building but were turned as necessary to reach the members behind their stiff legs.

A platform at street level was laid through the center of the building on the first floor beams, and on it the steel work for the upper stories was delivered by trucks, several of which could be driven in from the street and await a convenient time for unloading without obstructing traffic. The steel was hoisted through the floor panels by the main derricks and either set in final position at the same operation, or distributed on the last finished tier and assembled later. The rapid erection of the steel work is shown by the two accompanying pictures taken on July 9 and October 8, 1904. In the three months' interval the sixteen upper stories had been erected, roof and cornice built, all the floors constructed except the four upper ones, and the wall construction begun in the four lower stories.

The rapidity of the wall construction was very much promoted by the use of the movable scaffolds supported from above on a system which did not require any change of support for the numerous successive stories and permitted the use of any number of scaffolds one above the other for different stories simultaneously, thus saving much time that otherwise would have been wasted by the masons in waiting for scaffolds to be shifted. As soon as the framework was completed steel wire cables were suspended from the top and were arranged in pairs to which were clamped at any or every story as required, transverse beams on which the scaffold planks were laid. These beams could, obviously, be placed at any height and while the masons were working below, and as soon as the latter were done at one place the longitudinal scaffold planks were easily and quickly moved to the upper beams, and so on. The wire ropes were longer than were required and their lower ends were coiled up and secured so as to be out of the way. The weight of structural steel in the building is about 2,400 tons, and it was erected in less than four months.

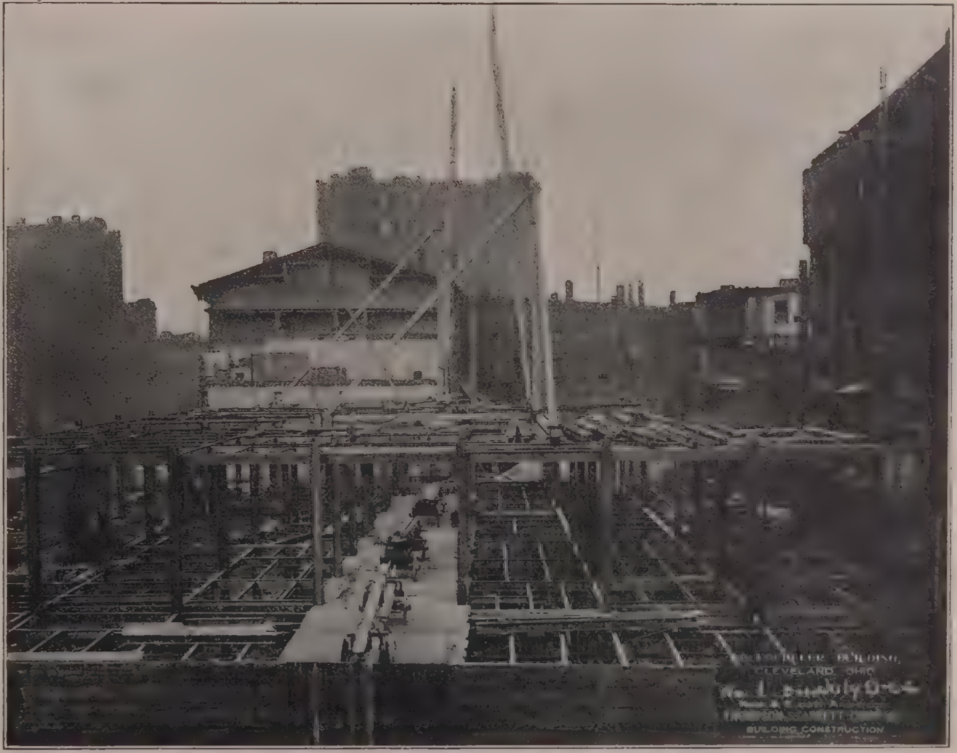
Messrs. Knox & Elliot, of Cleveland, were the architects. The structural steel work was designed by Mr. J. C. Spencer, C. E., and furnished by the Forest City Steel & Iron Co., Cleveland, and erected by the Thompson-Starrett Co., New York, who was the general contractor.



Completed Framework with Suspended Scaffolds for Bricklayers.

A Back-Feed Refuse Destructor.

A refuse destructor, with charging doors at the back and clinkering doors at the front, providing for the complete separation of feeding and clinkering, has just been put in operation at Luton, England. The plant consists of two Horsfall cells and is designed to destroy 30 tons of ordinary house and market refuse per day. The drying hearth is immediately over the main flue at the back of the furnaces and in the center of each clinker door is a small door through which the furnace can be trimmed and raked without opening the main door. The gases pass from the main flue of the destructor to a centrifugal dust catcher, which is described in the "Surveyor" as a circular brick building, 12 ft. in external diameter and over 12 ft. high, consisting of an outer chamber or shell lined with fire brick and a concentric inner chamber communicating with the outer one at the top. The gases enter the outer chamber at the bottom, pass around and upwards in the annular space between the two chambers. They enter the inner chamber through the open space at the top and pass from the bottom of this chamber to the chimney. The gases are used in generating steam which is utilized in a sewage pumping plant connected with the destructor.



Erecting Derricks and Delivery of Material through Building.

Some Features of Indirect Heating.

By Konrad Meier, Consulting Heating and Ventilating Engineer, New York.

Indirect heating, as generally understood, is a method by which the usual medium, steam or water, does not transmit the heat directly, but imparts it first to air as an intermediate between the heating surfaces and the room to be warmed. There are three distinct ways in which this can be done, differing rather in constructive features than in the principle applied. They are illustrated by Figs. 1, 2 and 3. The first represents the circulating method, the air being returned and used over again, a scheme for heating, pure and simple. Fig. 2 represents the method by which air is taken from the outside and allowed to escape again into the atmosphere. The ventilation thus secured may be considered incidental, the air supply being limited by the heating requirement. The method outlined in Fig. 3 provides for air supply irrespective of the changing need for heat by combining the apparatus for warming with that for a systematic renewal of air. Each of these three schemes has its field for application. Their respective merits are well enough understood, the points of difference are mentioned here only for the purposes of argument.

The correct way of determining the heat requirement, or the capacity of apparatus needed, with any system, is by the calculation of heat transmission through windows, walls and other surfaces exposed to lower temperature, with allowances for various other factors involving loss of heat. This is the only safe method to be used for indirect heating apparatus, since the empirical relation to cubical contents, or the old thumb rules for glass, would here become still more uncertain than is the case with direct radiation. While the latter is practically bound to deliver to a room the heat it may receive, the success of the former depends upon the proper circulation of air between the surfaces and the room. If this is to be effected economically, it must be calculated in the basis of the heat loss in thermal units, which usually determines also the heat needed for ventilation.

Assuming that the thermal units per hour necessary to maintain a desired temperature in a room have been figured up, the next step in the calculation for an indirect system will be to decide on the temperature at which the air is to enter, or its excess over that in the room to be warmed. This difference defines the volume of air necessary to do the heating, which is

$$\frac{T.\ U.\ per\ hour}{0.0192\ (t - t_1)}\ cu.\ ft.\ per\ hour.$$

This determines at the same time the amount of heat involved for ventilation, which is

$$cu.\ ft.\ per\ hour \times 0.0192\ (t - t_2)\ T.\ U.$$

The notation employed in these equations is as follows:

t = Temperature in heat flue.
t_1 = " " room.
t_2 = " outside.
a = Area in sq. ft. of duct and flue.
l = Length in ft. of duct and flue.
c = circumference of duct and flue.
S = Surface in stack (sq. ft.).
r_1, r_2 and r_3 = Items of resistance to flow of air.
m = Mean level of cooled space (room).
m_1 = " " " heated space (stack).

Lower flue temperatures, therefore, require more air to do the heating. They are preferable for hygienic reasons, while high flue temperatures make for economy in first cost and operation through the reduction of ventilation. For exposed rooms it may be taken higher than in those which need little heat, but should have plenty of air. It has been found safe in practice to assume t at from 120° to 130° Fahr. for steam heating apparatus, and 110° to 120° F. for hot water heating surfaces. Higher temperatures are undesirable hygienically, while lower temperatures mean impracticable dimensions of apparatus and greater fuel consumption than would ordinarily be justified. In the latter case, if the difference $t - t_1$ is very small, it may, under wind pressure, be reduced to a point where the increased volume, although it brings more heat in total, leaves too little margin available to cover the loss by transmission in addition to that for ventilation.

The efficiency of indirect stacks, or the thermal units transmitted per square foot of surface per hour, depends primarily upon the differences of temperature between the two exchanging fluids. Since nearly all the heat is emitted by convection and almost none by radiation, the rate must depend largely upon the velocities maintained outside as well as inside of the transmitting surface. High velocities keep up a greater difference through the rapid exchange of the warmed or cooled layer of fluid next to the intervening substance, while low velocities allow the mediums to approach more closely in temperature. Experimental data for transmission between various fluids and through different materials, as found in textbooks, do not always agree because the tests from which they are derived have been made under slightly different conditions, affecting the actual temperatures next to the transmitting surfaces.

The kind and thickness of metal are important factors for the rapid rate of transmission taking place from steam or water to water, but these items have comparatively small bearing when heat is conveyed from steam or water to air. However, they should be considered, especially when the surface used in stacks is of the extended type with ribs or pins. As the inside receiving the heat becomes smaller compared with the outside emitting it, this kind of surface loses materially in transmitting power per unit of area. The following may be considered safe values per hour for one square foot of surface and one degree Fahrenheit difference between steam or water and air.

Velocity between sections, ft. per sec.	3	4	5	6
Extended surface (rib or pin) T. U..	1.8	2.1	2.4	2.7
Prime cast iron surface (plain) T. U.	2.2	2.6	3.0	3.4
Wrought iron pipe coils (staggered), T. U.	2.5	3.0	3.5	4.0

These figures are largely empirical. Complete tests for the standard makes of commercial heating stacks under varying velocities and covering all conditions occurring in practice, if made at all, do not seem to have been published so far. Such information from a reliable source would be most welcome to heating engineers. It would be desirable also to have accurate data on the clear area between sections or loops, extended and plain, in order to define its relation to the flue area. Since the velocity obtainable or desirable in the stack may vary considerably, as will be shown, it is important to dispose the heating surface so as to give the corresponding free area for the passage or air. If assumed too small, the increased resistance will reduce the volume delivered, and to a lesser extent also the amount of heat transmitted. If too much area is given, the efficiency becomes smaller and more surface or greater depth would be required to secure a given rise in temperature.

The difference to be entered as a factor in the calculation of surface is that between the mean air temperature in the stack, and that of the fluid circulating inside. If the latter is steam, its temperature is given by the pressure carried. For hot water heating the mean temperature between flow and return is to be taken as a basis. This is usually from 10° to 15° lower than the maximum at the boiler outlet.

The volume of air for heating and its temperature, also the heating surface necessary, can be assumed and determined with sufficient accuracy on the basis of the above data. They apply equally to any of the three schemes. As previously mentioned, the success of indirect heating depends largely upon the proper circulation of air between the heating surfaces and the room to be warmed. It is necessary, therefore, to be able to foretell the air velocities that can be depended upon in order to give the proper dimensions to the flues and ducts and to verify those assumed for the stacks.

The first point to be established is the correct basis for calculating the motive power, or the proper heights and differences of temperature which determine the theoretical velocity. When these factors are known, we can estimate the net effect that may, in a given case, be obtained, or the actual velocity.

The natural means for moving the desired amount of air, is its own heat, converted into motion through expansion or its decrease in density—in other words, by gravity. If worked out purely as a heating arrangement, the gravity method is the most economical, since no heat is wasted thereby except what is unavoidably lost in transit. The power obtainable by gravity is dependent upon the height of the columns unbalanced by unequal density, and the difference of temperature which produces the latter. Of the total pressure head due to these two factors, a portion is expended to overcome the resistance to the flow presented by the air passages, generally known as the friction head. Only the balance, or the velocity head, is available for producing motion. To determine this balance under the various conditions likely to maintain is the problem. These conditions apparently differ with the method of heating to be applied, and yet they can be brought together under one general rule as will be shown.

The simplest possible case is represented by scheme 1, indirect heating by circulation. The room to be warmed may be regarded as a chamber where the circulating air is cooled, the stack being the chamber where it is reheated, the system being a circuit identical to that in hot water heating where the colder or heavier fluid constantly seeks the lower level. The differences in mean density or temperature and mean level, define here the gross power, although the full range of temperature only maintains for the height h. The height h_2, however, aids in creating circulation and practically the same result is secured as if the flues were carried up to the mean level m.

Scheme 2, indirect heating with fresh air and free escape, presupposes that the capacity of the vent flue is equal to that of the heat flue, as the air supply is limited to the heating requirements. In other words, the vent is supposed to be a portion of the ascending column in a circuit between inside and outside air. The capacity of the system might be figured on that assumption, in sections with the height h and h_3 and the respective differences of temperature $t - t_2$ and $t_1 - t_2$. Theoretically, this would be correct if a pressure could be maintained within the room corresponding to its position in the rising column of warm air. Practically, this condition is only approached under the most favorable circumstances. Leakage and communication with other rooms will create a neutral zone within the space to be warmed, that is, they would spill any excess of pressure and produce a condition identical to that maintaining for scheme 1. If the vent is of the same capacity as the heat flue, as it should be, and as it is bound to be with the circulating plan, we can safely calculate the capacity of the heat flue on a corresponding basis since the effect of t_2 on the small heights that might enter is negligible.

Scheme 3, indirect heating combined with ventilation, is usually designed with by-passes to admit air when no heat is needed, and with tempering coils to prevent the fresh air, when not passing through the stacks, from chilling the room. The exhaust flues should have the capacity to remove the desired volume of air, at least where and when the atmosphere conditions do not make it advisable to use the windows. If impracticable by gravity, this exhaust must be secured mechanically. Aspirating coils are uneconomical and should be used only where no waste heat is available or other motive power is out of the question. Gravity vents, when based on moderate outside temperatures are liable to be too active in cold weather, and, unless easily controlled, they may impair the heating. Likewise, aspirating hoods are only effective on windy days when least required. It is advisable therefore, to make the exhaust independent, as far as practicable, of the atmospheric conditions. If so designed it should maintain a fairly constant suction in the room, affected slightly perhaps through the use of by-passes which reduce the flue temperature and with it the pressure head for inflow, but at the same time eliminate the resistance presented by the stack. At the lowest outside temperature the actual velocity head in the heat flue, with the heating surface in full use, should give it a capacity equal to that of the exhaust flue, that is, deliver the volume of air desired for ventilation at the temperature as needed for heating. If the apparatus is designed and proportioned to accomplish this, we have again the neutral zone within the room, or a condition where no back pressure or suction should exist and may therefore assume again the corresponding heights and temperatures for calculating the velocity in the heat flues as for schemes 1 and 2.

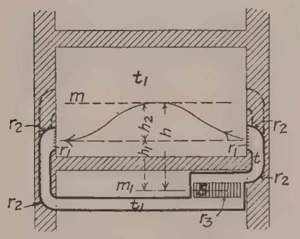


FIG. 1 Indirect Heating by Circulation.

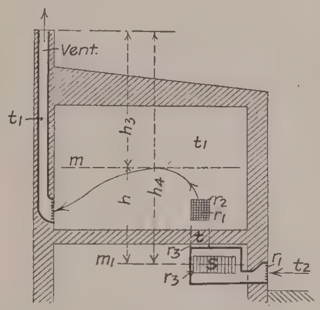


FIG. 2 Indirect Heating with Free Escape.

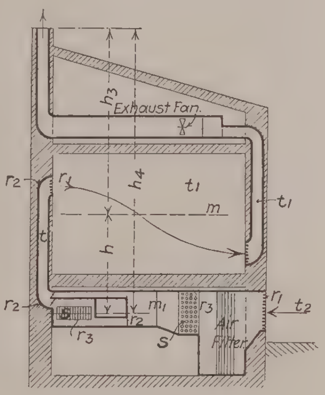


FIG. 3 Indirect Heating with Ventilation.

This velocity has roughly been assumed to equal about half of the theoretical, or that due to the total pressure head, but in reality it is often considerably smaller. The handbooks of Fischer and Rietschel give the accurate method of calculating the velocity obtainable, which is adapted here to American practice and presented in simpler form.

The theoretical or total pressure available is equal to the product of the height, *h*, and the density of the air. If the two columns are under the same atmospheric pressure the density in question is purely that due to difference in absolute temperatures and the head can be expressed by

$$Pt = h.d \frac{T}{t - t_1}.$$

The loss of pressure due to resistance, or the friction head, *Pr*, increases with the square of the velocity. The latter is the controlling element in the calculation and must be assumed tentatively in order to arrive at the actual value obtainable. According to Weisbach's general formula the friction head

$$Pr = d \frac{v^2}{2g} . f.l \frac{c}{a}$$

wherein *f* is the co-efficient for friction, expressing the degree of roughness of dustwork, etc. For sheet iron pipe Snow gives a value of 0.006. According to reliable tests on large steel pipe recently made by Brabbee in Austria *f* is 0.0043 and may be considered constant at any speed and size of duct. For smoothly built galvanized iron works 0.005 would therefore seem about the proper value. The factors *l*, *c* and *a*, respectively, denote length, circumference and area of the air passage for which the resistance is to be determined. The above formula of course maintains only for a straight run of uniform area and dimension. The extra resistance created by bends, changes in shape, registers and stacks must be added to the value of *flc/a*, all these items increasing with the square of the velocity.

In the case of Fig. 1, for a practically uniform cross-section, the friction head would be

$$Pr = d \frac{v^2}{2g} \left(f \frac{l.c + s}{a} + r_1 + 2r_2 + r_3 + 2r_2 + r_1 \right)$$

To $l \times c$, the interior surface of the duct system, should be added the heating surface of the stack. The resistance through registers r_1 depends greatly upon the free area. If only equal to that of the flue the value may vary from 1 to 1.5. If larger, the resistance drops rapidly and may be assumed at from 0.5 to 0.75 for 1½ times the flue area with fairly open designs. Large mesh wire screens, open dampers and register valves present very little resistance. The value of r_2 of course depends upon the radius and may vary from nothing for long turn bends to 1.5 for sharp right angle knees. The resistance through stacks r_3 must be derived from the repeated expansion and contraction, also from the deflection of air by the loops, and the changes of velocity and direction at inlets and outlets of casing. According to the character of the surface and the depth of stack, or number of pipes, r_3 may vary from 2.5 to 4 in average practice. This figure can be derived approximately from the ratio between the areas of flue and casing, expressed by $\left(\frac{a_1}{a} - 1\right)^2$, to which 0.2 to 0.3 is to be added for each loop or pipe making up the depth of stack.

The total pressure head and the loss of friction being determined, the head available for producing the actual velocity would be $Pt - Pr$, and accordingly

$$v = \sqrt{2g \frac{Pt - Pr}{d}}.$$

If *v* is found to be larger or smaller than assumed, the calculation for *Pr* has to be corrected by an intermediate value until the result checks within the limits of error.

Taking for example $h = 10$ ft., $t = 125°$, $t_1 = 70°$, then the total head pressure would figure

$$Pt = 10 \times .078 \left(\frac{125 - 70}{461 + 70} \right) = 0.081 \text{ lb. per sq. ft.}$$

and the velocity due to this head would be

$$v = \sqrt{64.4 \frac{0.081}{0.078}} = 8.2 \text{ ft. per second.}$$

If the actual velocity is tentatively assumed to be 4 ft. and the plans give $l = 25$ ft., $c = 6$ ft., $a = 2$ sq. ft., and the heating surface, of plain character, at $2.6 \times 120 = 310$ T. U. efficiency, is taken to be 70 sq. ft. then

$$Pr = .078 \frac{16}{64.4} \left(.005 \frac{25 \times 6 + 70}{2} + 0.6 + 2 + \times 0.4 + 2.5 + 2 \times 0.4 + 0.6 \right)$$
$$= .113 \text{ lbs. per sq. ft.}$$

At a 4 ft. velocity the resistance would therefore exceed the total pressure available. In other words, the assumed velocity cannot under the given circumstances be obtained. With 3 ft. as a tentative, the friction head will figure 0.064 lb. per sq. ft. and the velocity head accordingly $0.081 - .064 = .017$ lb., giving

$$v = \sqrt{64.4 \frac{0.017}{0.078}} = 3.8 \text{ ft. per second.}$$

That is, if the flue areas were based on 3 ft., the reduced resistance would let pass more air than is intended. With $v = 3.1$ ft., the actual velocity will check closely with that assumed. The velocity obtainable in this case is, therefore, only about 38 degrees of the theoretical.

It is manifestly impracticable to figure each individual flue on these lines, inasmuch as the deviations from the plan in actual construction would render a close calculation useless. But a study of the factors which would be likely to enter such a calculation will enable the designer to estimate the ratio between the actual and the theoretical velocities, which would give the simple rule to be applied in ordinary practice. This ratio does not depend upon the height and differences of temperature, or the total pressure head, but is controlled entirely by the resistances, some of which are given by structural conditions while others are variable. We can increase the percentage for instance by reducing the resistance through the stacks, that is, by spreading the heating surface. To increase the free area through the latter by 25 per cent. will reduce the velocity at that point to 80 per cent. and the friction, or the factor r_3, to 64 per cent. Strictly figuring, the value for *S* should also be corrected on the basis of lower velocity, but with an increase of surface needed. In the above example r_3 would be reduced from 2.5 to 1.6. The actual velocity thus obtainable would figure 3.35 ft. per second, and the ratio 41 per cent. Since the other factors are practically predetermined, the resistance through the stacks is about the only means to accelerate the flow if desirable.

Generally speaking, it is desirable to make the free area in the stack about equal to that in the flue for low heads of one story. Any considerable increase in connection with a fresh air system would reduce the resistance to a point where the wind pressure might prove too great a factor, admitting more air than can be heated. With greater flue heights it is advantageous to increase the free area through the stack about 10 per cent. for each additional story.

In calculating extreme cases as they occur in practice, long and short runs, crooked and otherwise, we may find the above ratio to vary from about one-third to one-half for indirect heating proportioned on the lines indicated. The theoretical velocities can easily be tabulated, and used in connection with above ratio as the case may require. With the velocity thus determined, the efficiency and amount of the heating surface should be verified. For the example figured above, the efficiency would be only 2.24 T. U. at 3.1 ft. velocity instead of 2.6 T. U. as assumed with 4 ft. velocity. The heating surface accordingly should be made 80 sq. ft. instead of 70 sq. ft.

With scheme 2, the loss of head by friction would, for the case illustrated, be reduced by two heads, $2r_2 = 0.8$, but the extra resistance through the greater heating surface needed might increase the total loss of pressure. On the whole, the ratio between the actual and theoretical velocities is governed by the same conditions.

The size of the vent flue should be figured on the basis of $t_1 - t_2$ and the height h_3, using the formulas given above, but omitting the irrelevant factors for resistance.

It will be found in practice, that the actual velocity in vent flues varies between half and two-thirds of the theoretical, depending upon horizontal runs, turns and other obstructions.

When the ventilating requirements make it desirable scheme 3 should be laid out with air filters and with tempering coils. These items have a distinct bearing on the flow of air. For main ducts supplying a number of stacks and flues with varying velocities, it is advisable to assume the average of the latter a basis for calculating resistance. Likewise the mean velocity through the tempering coils should be equal to the average within the stacks. The factor r_3 for the coils depends on the number of pipes traversed, each row adding about 0.2 to the value $\left(\frac{a_1}{a} - 1\right)^2$. Thus 10 rows will make $r_3 = \left(\frac{2}{1} - 1\right)^2 + 10 \times 0.2 = 3$, if the expansion and contraction is from 1 to 2 to 1 at the inlet and outlet of casing, and for a velocity between equal to that in the duct, or about 2.5 if reduced by 10 per cent. The air filters are a very uncertain element, depending greatly upon the area and upon their condition. If the resistance through cheese cloth is to be overcome by gravity apparatus, the air should be made to travel very slowly. According to the velocity head available, 0.25 ft. per second should not be exceeded, unless the best attention in cleaning the screens can be expected. It is necessary in such cases to minimize carefully the resistance in all parts, in order to obtain as much as one-third of the theoretical velocity.

The foregoing argument should have made it clear how many different elements may affect the proper working of an indirect heating apparatus. Design should go hand in hand with calculation, and with a view to secure as near as possible the assumed working condition for schemes 1, 2 or 3, as the case may be. The pressures resulting from the differences of temperature and height upon which we must usually depend are slight compared with the pressure exerted by high winds through leaky walls and windows. To neutralize their effect on the room, it is essential that the air inlet should have the same exposure as the room which it supplies, thus incidentally providing the means to increase the heating capacity when it might be needed.

Considering all the uncertain factors which enter the problem, even approximate calculations may not seem justified, but a study of each case in its bearing on the physical laws as supplied above should prevent errors of judgment, and should at least yield a correct estimate of the factors in the practical rules deduced. This will be a safer basis for approximate figuring than the prevailing methods and should eventually lead to that true common sense in engineering which is the result of intimate knowledge.

The capacity of an apparatus to furnish the heat required should not be the only end in view. There are further obligations towards the victim of this science of warming which are too often ignored. Indirect heating, unless installed as a circulating system, for a make-shift, or for appearance sake, of course also provides ventilation. If we are to get the full benefit from this feature, the fresh air introduced must be pure, not too dry and of equable temperature.

Some control over purity can be obtained, if necessary, by air filters, at least when installed so that they will be properly handled. Whether the solid impurities are so arrested or not, all horizontal air passages, and any other parts where dust can settle should be made accessible for cleaning. Radiators, and indirect stacks in particular, ought to be built according to sanitary principles. Most of the commercial forms of indirect radiation are unhygienic, being very inconvenient to keep clean, and thus practically doomed to become a receptacle for dirt and dust. As a rule this is never removed, and kept from piling up only through the action of the air currents when the apparatus is in use. In other words, the stacks gather dust and disease germs when cold, and no air current exists. So long as this impure and objectionable matter lays there, it will molest no one, it remains latent so to speak. But as soon as heat is turned on, the dust is liberated, being freed from all moisture, lightened and set in motion by the heated air, thus contaminating the supply before it reaches the room and reducing the benefit derived by the ventilation.

Much has been said of late about the desirability of moistening the air during the heating season. Dry air indoors is undesirable principally by reason of its containing more of the fine dust imparted to it by the heating system. While some of this can be eliminated by greater salubrity and the proper apparatus inducing it, these impurities are largely a condition incident to city life, more or less to all indoor life. A certain amount of humidity in the air unquestionably is desirable for respiration, and in a measure also in regulating the thermal activity of the human body by preventing excessive evaporation. The influence of moisture in the air on the sensible heat is a matter of common knowledge. Rooms can be kept comfortable at lower temperature if moisture is supplied with the heat, but the amount desirable in a given case, and its true bearing on the heating requirement, are still subject to controversy. Some notes on the subject will be found in the writer's "Reflections on Heating and Ventilating Engineering." The moistening enters of course into the thermal calculations for heating apparatus so equipped. The deficiency to be made up depends primarily upon the difference between inside and outside temperature and relative humidity, secondarily upon the relation of the air supply to internal sources of moisture, such as the occupants of a room. Where indirect heat is used the latter item is generally about offset by leakage. The maximum amount of water to be evaporated and absorbed by the air or the capacity of the moistener is determined by the lowest humidity likely to prevail outdoors, and the percentage desired, or economically obtainable indoors under these conditions. For the climate of New York a liberal allowance would be based on 30 per cent. relative humidity at zero, to be raised to 40 per cent. at 68° F. which requires about 0.4 lb. of water to be evaporated for each cubic foot of air supplied for indirect heating.

The most convenient method of air moistening is that of evaporation in open pans heated by submerged steam coils. The heating surface required is determined by the rate of heat transmission which is approximately, per one degree Fahr. above the boiling point (for steam)

For galvanized iron pipe coils 125 T. U. per sq. ft.
For brass pipe coils........500 T. U. per sq. ft.
For copper pipe coils........600 T. U. per sq. ft.

If the water is brought to or near the boiling point the evaporating surface does not materially affect the result. In hot water heating work the only available means is usually a coil on the circulating system submerged in a wide pan. To secure sufficient evaporation, the surface of the water must be very liberal. It is impracticable as a rule to effect the same rise in humidity by this means as in steam heating, but the need for it is distinctly less, since the lower temperature of heating surfaces does not produce the so-called drying effect of steam, which is merely the additional dust, dried up, distilled and carried into the room. The vitiating influence upon the air of heating surfaces at high temperatures, unless kept scrupulously clean, is only partially neutralized by moistening.

With steam heating, the percentage of humidity should be put under perfect control to prevent undesirable excess. The varying temperature of hot water systems according to the heating need makes this control automatic to an extent and the danger of too much saturation is remote.

The regulation of temperature is also very desirable from a hygienic point of view. Hand control by means of the heat registers is more convenient than the operation of valves on direct radiators, but is proper only in connection with schemes 1 and 2, strictly applied for heating. With scheme 3 when tempering coils, by-passes and double or mixing dampers are used, automatic control becomes almost a necessity, especially with steam heat. In either case regulation is more immediate and effective through the control of the air by dampers than through the primary heat carrier, aside from the danger of freezing.

Indirect heating has many advantages in theory, which need not be repeated here. If these are to be realized in practice, the prevailing mode of application must be improved upon. Capacities should be based on heat loss by transmission and ventilation, systematically calculated. Dimensions and proportions ought to be determined not by thumb rule, but on the basis of physical laws as near as we can estimate their bearing on a given case. Design and calculation must go hand in hand. There should be more substantial construction of apparatus generally, and with due regard to sanitary principles, especially as to inducing salubrity. The average heating work at the present time is distinctly of a lower grade than for instance the up-to-date plumbing, in the perfection of details, materials, workmanship, as well as in regard to hygienic quality.

A Long, Continuous Sewer of 12-in. pipe was recently laid at Rocky Ford, Colo., by the Piper Bros. Co., Pueblo. Over 6,800 ft. was on a straight line, and it was possible to look through it from one end to the other. On this work one of the pipe layers put in 1,030 ft. of 8-in. pipe in 8 hr. 15 min. The trench was 7 ft. deep and was laid with a top line.

The M. I. T. Faculty and the Harvard Alliance.

On May 5 the faculty of the Massachusetts Institute of Technology discussed the proposed alliance of that college with Harvard University and decided against it by a vote of 56 to 7, two members being absent in Europe. Majority and minority reports have been made, stating very fully the divergent views of the two sections of the faculty, and the following abstract of them gives a general idea of the leading points at issue:

Majority Report.—In discussing the wisdom of a radical departure in the conditions of our work, it is necessary to set forth briefly the educational ideals which have guided the policy of the Institute. In its beginning the Institute stood alone in being a "school of scientific technology." It still remains true to its original intent, to furnish "that systematic training in the applied sciences which can alone give to the industrial classes a sure mastery over the materials and processes with which they are concerned," basing that training upon "a thorough knowledge of scientific laws and principles," and uniting "with habits of close observation and exact reasoning a large general cultivation."

The organic life of the school has shown a steady development. In the last decade new courses have been added in electro-chemistry and mining geology. Several of the older professional courses, as geology, electrical engineering, and chemical engineering, have undergone thorough revision. Even where the revision has not been complete, there have been made each year changes in subject-matter or readjustment in the distribution of hours. On the material side this development has resulted in new laboratories for biology, mineralogy, electrical engineering, and research in sanitary science and physical chemistry. The entrance standards have been raised by a considerable increase in the requirements in mathematics and modern languages, and by the addition of physics and of an elective subject. Special research departments of sanitary science and physical chemistry and a graduate school of engineering research have been established, as well as a course designed for assistant naval constructors assigned by the United States Navy Department.

The Institute has also been alive to the general welfare of its students. The internal administration of the school has been reorganized by the creation of the office of dean, a part of whose duty is to act as general consulting officer for all the students. Clubs and societies have been developed under helpful influence, and a fund of experience has been accumulated, which will prove fruitful in improving student conditions along natural and economical lines.

The successful development of the Institute in these various directions is not set forth in any spirit of self-satisfaction, but simply as evidence that the system of independent technological education for which the Institute stands is fundamentally sound. The development of technological education in Europe confirms this belief. The technical schools of Germany, France, and Switzerland are in their organization and faculties distinct from the universities, though in Germany all classes of schools are, of course, under the control of the ministers of education of the several states.

The history of the Massachusetts Institute of Technology also shows the advantage accruing from independence in the case of an institution in which scientific studies are pursued at the same time with the so-called humane studies in a carefully co-ordinated course of four years. In the attempt to give such a course of instruction the Institute has naturally encountered difficulties and committed errors. It is true that the curriculum is crowded, and that general studies take a subordinate place, with the result that at the time of his graduation the Institute alumnus is often lacking in breadth. The proper way for the Institute to mitigate such evils is not to break with a successful past, but to modify the curriculum by a sympathetic interpretation of our own traditions and in accordance with the advice of loyal alumni.

In the list of advantages to the Institute connected with the proposed agreement, removal to the Brighton location has been included by few. President Pritchett does not view it with complete favor, and opinions differ merely as to the degree of disadvantage. At present 44 per cent. of our students live at their own homes, with advantage to themselves and to the Institute. Undoubtedly this has an important conservative effect in determining the atmosphere of the Institute. Removal to a more distant site would greatly decrease this number, and increase the total cost of living to the student body. It would also introduce the problem of establishing a dormitory system—a problem altogether too important to be settled thus incidentally.

On the other hand, our present site has contributed in no small degree to the distant individuality of the Institute. This site, in a busy city, is by many regarded as one of our most valuable educational assets, and has great strategic advantages. Students can live in any of the surrounding suburbs. The central location attracts to our halls educational and engineering bodies that help to make a professional atmosphere, and assist in advertising the Institute to a scientific constituency of the utmost importance.

One argument which has been urged as diminishing the objections to the proposed location of the Institute is the belief that removal from the present site will be in any case inevitable, or at least highly desirable, within the near future. As bearing upon the necessity of removal, reference may be made to plans which have been prepared for covering with suitable buildings all the Institute's present land in the space between Trinity Place, Stanhope, and Clarendon Streets. These plans show that 51 per cent. could be added in this way to the floor space devoted to class rooms and laboratories, thus making ample provision for 1,800 to 1,900 students. In addition, the Walker Memorial Gymnasium can be constructed upon the same site. Moreover, a larger portion of the Boylston Street land will become available if a favorable decision as to removal of the restrictions upon it is rendered by the courts.

Moreover, with regard to the effect of removal under the prescribed conditions to a site in such close proximity to Harvard University, it is the opinion of the faculty that a closer union with Harvard would inevitably follow, impairing if not destroying the individuality of the Institute.

In connection with the proposed alliance, much has been said of the avoidance of educational duplication. It has been explained to us that the intention is to continue in the Institute both instruction and the granting of degrees in such branches of pure science as chemistry, physics, geology and biology. There is reason to believe that the University contemplates the retention of instruction and degree giving in all these subjects, as well as the retention of elementary instruction in at least some branches of industrial science as college electives. The University also reserves its right to grant any and all degrees, in applied science as well as in pure science; but the agreement implies that Harvard degrees in applied science would hereafter be granted only upon the recommendation of the faculty of the Institute.

It will be natural for a student intending to get an engineering degree to take his elementary work in the college. That such a result is anticipated by the framers of the agreement would appear from the statement of President Pritchett that the stronger technical schools are to take a forward step by which they will be free from much elementary work.

Two special causes are likely to contribute largely to this result. The first is that the tuition fee at Harvard is $100 less than that of the Institute. Even if the fees were to be equalized, there yet remains the second fact that participation in University athletics is open only to students enrolled at Harvard. Boys who are intending ultimately to become engineers, but who are also ambitious of athletic distinction, or even those who desire the real use rather than the partial privilege of the Harvard playgrounds, would be likely to take their elementary work in the college rather than in the Institute.

Yet the most serious effect upon our curriculum, in consequence of such a change of methods, would be the loss of that absolute control over our instruction which we consider essential to the maintenance of our standards. If we turn over our elementary scientific work to another faculty, whose educational purposes and methods are essentially different from ours, we make impossible that close co-ordination of studies which we consider a prerequisite of successful technological education.

A further disadvantage of the proposed agreement is the modification that it makes in the present method of government of the Institute. A new executive committee is created, of which at least three members out of nine shall be members of the Corporation of the University. It is our opinion that under this agreement the "organization, control and traditions" of the Massachusetts Institute of Technology would not be so safeguarded as to inspire that confidence in the preservation of its individuality and in the continuance of its educational autonomy which we regard as absolutely essential to the well-being of the Institute and to the efficiency of its work.

Akin to a change of control is the provision giving to both the Corporation and the overseers of the University the full right at all times to inspect the Institute and to make suggestions in regard to methods of management. This would clearly give to the alumni of Harvard College, whose official representatives the overseers of the University are, rights which are not constitutionally possessed by the alumni of the Institute, men whose training, interests and loyalty especially fit them to be advisers in the management of the school. Important educational problems must inevitably arise in the near future, in which this new executive committee would have the final voice. The disposition of the Department of Architecture, the establishment of new courses in pure science, the development of graduate work, the construction and administration of dormitories, the fixing of tuition fees, the maintenance of entrance examinations on a level differing from that demanded by the University—all these are subjects bearing on the educational relations of the Institute and the University which the executive committee would have to face in the near future.

A thoroughly objectionable section of the agreement is that which excludes the Department of Architecture from its provisions, leaving the future of one of the original and one of the most brilliantly successful departments of the Institute wholly unsettled and problematical. The explanation given us of this omission is that, for reasons seemingly conclusive, the Harvard Department of Architecture cannot be transferred or given up. This being so, the only form of combination possible would seem to be the cession by the Institute of this one department to Harvard University. Such a cession would mean the abandonment of a school which has created traditions and a method of training recognized throughout the country as of exceptional excellence.

Another disadvantage of the alliance is the danger that the interest and support of the graduates of the Institute will be sacrificed. An important element in the organic growth of an educational institution is a strong, well-organized association of its alumni, the men who can best appreciate the advantages and needs of the institution and who know the places where it can be strengthened. If the proposed alliance is accomplished, the interest of the alumni is sure to diminish with their diminished responsibility for the maintenance of the Institute, and may be altogether alienated. The loyalty of future graduates would at best be a divided sentiment.

The assertion has been made by some who favor this alliance that the prestige of the Institute is likely to suffer seriously from the rivalry of other technical schools, in various parts of the country, whose number and strength are rapidly increasing. In the opinion of the faculty our prestige can best be upheld, not by increasing the size of the Institute, but only by maintaining and improving the quality of its training. We therefore regard a step which would diminish our control over our students and cause a deterioration in the quality of their professional work as one sure to entail an ultimate and serious loss of prestige. In competition with the State universities in the West, where tuition is free, the Institute has not as yet been at any disadvantage, since the relative number of students which it draws from that very section continues to increase. That our advantage will continue in the future is made probable by the fact that they, as public institutions, have a less complete control than we possess over entrance requirements, and consequently over the preliminary training of their students.

The Institute does not suffer by comparison with technological schools connected with universities. At Cornell University, for example, the percentage of graduate students in the engineering departments for the past twelve years has fluctuated irregularly between extremes of 12.1 and 7.4, and is now 10.4. In the Institute, on the contrary, the percentage of college graduates has increased almost steadily from 4.6 in 1892 to 11.6 in 1904. In our Department of Architecture alone the number of college graduates has trebled during the past ten years. Furthermore, the Institute has for some years been distinguished by the National Government as the place at which the naval constructors from Annapolis shall receive their final technical training.

An institution which has passed beyond its formative period has a right, as a man has, to its own character and individuality. It has earned the right to grow and change along its own lines, and not to be violently wrenched out of them and made over, under new and untried influences, into something different from itself. Such a course might be justifiable as a desperate expedient in the case of a demoralized and decaying school. But the Institute is in no sense a decaying institution. While making no claim to perfection, it desires nothing so earnestly as a fuller and richer though not necessarily a larger growth.

In point of numbers, however, the Institute, despite a steady increase in its requirements for admission and an exceptionally high tuition fee, is more than holding its own, not only in Massachusetts, but throughout New England, and not only in New England but throughout the United States. Our defects—and no one is more conscious of them or more desirous to amend them than is the faculty—are in part consequences of growth and of success. In part, however, they are inevitable defects of the qualities which have made us what we are. The lack of academic leisure and of monumental college surroundings, and the absence of a great part of the social and athletic life of the typical American college—such losses are a necessary price which we and our students pay for the spirit of professional study, of business-like regularity, and of scientific accuracy. In the training of engineers we believe that these qualities are worth vastly more than the desirable things which we sacrifice in order to obtain them. While continuing to insist upon these qualities, we shall be glad, so far as we can safely do so, to diminish their defects. But we believe that we can best accomplish this by remaining free to deal with the problem by methods under our own control. With that high regard for the spirit of university life to be expected from a body of men more than half of whom, as is the case with this faculty, have received their training from colleges and universities, rather than exclusively from technological schools, we are nevertheless firmly convinced that the effect of direct contact and intermingling of our student body with the dormitory, social and athletic life of college undergraduates, under the conditions obtaining in this case, would be more harmful than beneficial, and that it would be little less than totally destructive of the established character and atmosphere of the Institute.

A successful and valuable school quite different from ours might no doubt be developed under university conditions, but that would much better be done independently, from such beginnings as already exist, rather than upon the basis of our reputation and at the cost of our individuality. With institutions, as with men, character is a thing which may be undermined and destroyed, but which cannot be bought or sold or transferred. The success of the Institute thus far has surely not been due to its wealth, to its superior equipment, or to large salaries paid to its instructing staff. Its success has been and still is a success mainly of character and morale; and it is precisely these vital qualities which the faculty believes would be destroyed by the changes called for under the terms of this proposed agreement. For it is not merely proposed to remove the Institute to a new site, but to graft it upon another institution.

Minority Report.—This report is signed by President Pritchett and Professors Fay, Jaggar, McKibben, Moore, Swain and Walker. It opens with the following statement of the details of the proposed alliance:

(*a*) Harvard University abandons the field of industrial science, diverts to the Institute all of its funds which are or may hereafter become available for this purpose, and in return asks a minority representation upon the executive committee of the Institute, the veto power over the disposal of funds contributed by it, and that the Institute move to a new site nearer to the University.

(*b*) The Institute is left in control of the field of industrial science in this community, and with its name, organization, control, traditions and substantial independence.

(*c*) The Harvard Faculty of Industrial Science is added to the Institute faculty and the number of students at the Institute will presumably be increased, since there will be one school instead of two.

(*d*) Under regulations to be prescribed by the two corporations, students in either institution may take courses in the other; and Institute students may have the use of the Harvard playgrounds, museums and libraries.

(*e*) The agreement takes effect when approved by both corporations and by the Supreme Court, and may be terminated by either party upon reasonable notice and under reasonable arrangements.

(*f*) The Departments of Architecture are not included in the agreement.

The Institute and Harvard College will be separate institutions as heretofore, except that, under proper regulations, work may be taken at both at the same time, as in the case of advanced students; but they will be allied and co-operating instead of competing. Harvard does not necessarily give up entirely the Lawrence Scientific School, nor abandon all instruction in industrial science. It may prove desirable for her to offer instruction in some branches of industrial science, such as drawing, surveying, mechanism and others, so that Harvard students who wish to enter the Institute after graduating may enter our third year. This would have many advantages over the plan of throwing such students into Institute classes during their undergraduate course at Harvard; but, as the Harvard faculty recommends no degrees in industrial science, and as her funds available for industrial science are given to the Institute, it is clear that she practically abandons this field.

The Institute Corporation will still control the Institute, as it appoints all the members of the executive committee. It is idle to speculate as to the possibilities by which there might at some future time be a majority of Harvard men upon the executive committee. The plan does not absorb the Institute in Harvard, but leaves both independent. Absorption or closer relations can only take place when and if the Institute Corporation is willing that they should take place, whether this plan is adopted or not.

The two Departments of Architecture are not included in the agreement for the reason that Harvard has a largely endowed department, the donors of which desire no change. Under the agreement each Department of Architecture would continue to be maintained by its own corporation. There seems no doubt that these sections legally provide for the continuance and maintenance of both departments; but, if there is any doubt, we think it should be removed.

If the plan is not adopted Harvard will be obliged to energetically develop the Lawrence Scientific School as a broad college of applied science. With her resources, reputation and large body of alumni, and profiting by the lessons of experience, there is no doubt that she can make this school a success. This is abundantly proved by the experience of other universities which have technical schools. This school will be a rival of the Institute in the same community.

Competition in business or in education always involves some economic waste. In education it is beneficial only if necessary to keep up the spur to endeavor. The Institute does not require competition with Harvard for this purpose, and without it will have ample competition with the rapidly growing schools of the Middle and Western States. Co-operation is better for the community than competition, for it involves economy and avoids duplication.

Of two competing schools, either one will be better than the other or they will be different. If Harvard should build up a great technical school, though ours might on the whole be the better, Harvard would undoubtedly draw to herself many strong students. Every strong student that we lose is a distinct disadvantage to us.

Technical education in this country is scarcely fifty years old. It is not yet on the same plane with instruction in the so-called learned professions. The time has not yet come for making engineering schools generally graduate schools, like so many of those of law and medicine. The Institute and most other engineering schools must remain primarily, for some time at least, undergraduate schools; but the level of industrial education will, in the course of time, be gradually lifted. When the university technical schools more generally reach the standard of the Institute—and some of them have already fully reached and perhaps in some respects exceeded it—is there not ground for believing that the young man who desires to qualify himself most completely for the engineering profession will seek the school which has the broadest environment, where he will be brought into relations with students of other professions?

The Institute having shown the way, there are now many technical schools where forty years ago there were few. A great majority of these are intimately connected with universities, and the fees at many of them are very low; they are doing excellent work, some as good work as the Institute; they have a much larger body of students; and they are turning out each year a much larger body of graduates than the isolated technical schools. May not our own influence diminish in the course of time, as the body of alumni of the university technical schools increases in number and in influence?

Competition from the West will increase. The industrial center of the country is shifting. As the years go by, new technical schools will be established in the West, at places like Chicago and Pittsburg, either independent or connected with universities. When they shall have had time to grow to their full development, what will be the effect upon the Institute of Technology, especially if it is isolated, out of the main current of educational development, and actively competing for support and students with another strong school not three miles distant?

If this agreement is rejected by the Institute Corporation, and Harvard energetically develops her technical school, Harvard alumni all over the country—lawyers, bankers, merchants, engineers, men in responsible positions in the great industries—will be enlisted in an active campaign to promote Harvard interests as against Institute interests. By allying ourselves with Harvard, we should gain the active support of this large and influential body of men instead of their opposition.

By combination and co-operation instead of competition there is economy in administration; in heads of departments; in libraries and photographs; in museums and collections; in lecture apparatus and similar appliances; in buildings, especially as regards large lecture rooms not often used; and, to a greater or less extent, in laboratory apparatus.

There is also an economy or an increase of efficiency in combination, with reference to the instructing force. With the same number of men that would be required for two separate institutions a single institution would allow greater specialization in the teaching, permitting the student to come in contact with a larger number of inspiring teachers, or it would enable more than one teacher to teach the same subject, thus stimulating each to do his best.

If Harvard energetically develops her technical school she will probably, in course of time, have more resources available than the Institute, considering her large number of wealthy alumni and their relations to the business world. The McKay will provides "that the salaries attached to the professorships maintained from the endowment be kept liberal, generation after generation, according to the standard of each successive generation, to the end that these professorships may always be attractive to able men, and that their effect may be to raise in some judicious measure the general scale of compensation for teachers of the university." In the course of time, therefore, when the McKay money becomes entirely available, it seems inevitable that Harvard will have a very high standard of salaries for professors in her technical school—probably much higher than those at the Institute. In this case she could attract to these positions the ablest men, who cannot now afford to be teachers because of the inadequate reward. Whether under these conditions the Institute would be the leader in technical education in this community is at least doubtful.

Increase in the number of students, if accompanied by corresponding adaptation or organization of the teaching force, should also conduce to economy and efficiency. The proposed plan would add a considerable number of professors, not necessarily of teachers of lower grade, and the result would be a gain in efficiency. With proper organization there should be a gain in efficiency, or, at all events, there should be no loss with increasing numbers, while the students would gain by the larger opportunities, the greater educational momentum of the institution, the larger circle of acquaintance and body of alumni.

Whether the plan is adopted or not, we can limit our numbers by raising the standard. If increase of numbers is a disadvantage, we should limit them in this way rather than in any arbitrary way. By adopting the proposed plan, we retain the field, and can get all the strongest students from this community. If there are two schools Harvard will very likely get as many as we do.

The addition of the Harvard faculty to that of the Institute would be a distinct gain. Whether all would harmoniously work together at once is of little consequence. Of all men the teacher is most likely to get into a rut. In-breeding emphasizes this tendency. The influx of a body of new men with other points of view than our own would tend to counteract it.

If the proposed plan should result in more intimate association between our faculty and the faculty of Harvard College, the result would be beneficial. The teacher of engineering or applied science should profit by the opportunity to mingle with those teaching widely different subjects, and should welcome every broadening influence.

Institute students are given a narrow training, and would benefit by association with men studying the humanities and the other professions. Remembering that the Institute students constitute a large and compact body, and that the faculty would hold them rigidly to their work, it seems probable that they would not mingle intimately with the Harvard undergraduate body, nor engage extensively in athletic contests. Such association as would occur would probably be of benefit to both sides, the Institute men gaining in breadth, the Harvard men in professional spirit.

Educational institutions must depend more and more upon gifts from wealthy men. Harvard University and the Institute are in the same community. They must appeal for support to the same class of persons, and in many cases to the same individuals. If the two were working together, the financial results would be better than if the two were working separately and in opposition to each other.

Rich men who have large sums of money to give away desire to have their gifts expended economically, and, as a rule, they believe that economy results from combination and co-operation rather than from competition. If this agreement should be declined by the Institute, many of them would say that the Institute was unwilling to co-operate, and thereby increase efficiency and economy, while Harvard University was willing to co-operate. This attitude would render them less likely to give to the Institute.

In connecting an undergraduate technical school with a college, certain principles should be observed: (*a*) the technical students should not be made to feel, through any attitude of the authorities, officers, or students, that the utilitarian pursuit of science is in any way inferior to the pursuit of the humanities, of pure science, or of other professions; (*b*) the faculty of industrial science should be separate from the college faculty, and free to adopt its own regulations, its own standard of work, and its own methods; (*c*) it would seem on the whole better that the student bodies should not be closely amalgamated by throwing them into the same classes; their association should be what would naturally result from outside interests (although very strong evidence is not lacking, as we have seen, in favor of a more intimate amalgamation). The present plan seems to offer almost the ideal form of affiliation.

The plan proposed would be of advantage to Harvard for many of the reasons which have already been adduced. Hampered by the rivalry of the Institute, her development would be retarded; by allying herself with the Institute, the necessity of duplicating our plant and faculty would be obviated, and yet she could energetically advance the cause of technical education in this community, both with money and with influence. Instead of gradually building up an engineering school with a student body which for some time would be much less numerous than the college undergraduates, her technical students and ours would at once constitute, as already stated, a larger body than the Harvard College undergraduates. The Institute would be in a certain sense Harvard's technical school, and Harvard's interests as much as those of the Institute would consist in making it as great and as efficient as possible.

Book Notes.

The series of related manuals entitled "Telephony," which is being written by Mr. A. V. Abbott to furnish a complete exposition of the design, construction and operation of telephone exchanges, has lately been enlarged by a fifth part, on "The Substation." It is a 12-mo book of nearly 500 pages, and discusses receivers, transmitters, induction coils and sub-station circuits, transmission and current supply, signaling apparatus, protection, party lines, sub-station assemblage, and the cost of installation and operation. This volume will probably interest a larger number of readers than others in the series, because it explains very clearly the construction of the leading types of instruments which the subscribers use. They know of central stations and trunk lines in a hazy way, but the instruments at their offices and homes have become a part of their daily environment. Mr. Abbott's new book gives a clear and concise account of these instruments, and is recommended to those who do not care to examine further into telephony. It is not unlikely, however, that many readers of this volume will wish to secure the others of the series and study the whole subject of modern telephone practice. New York, McGraw Publishing Co., $1.00.)

Few Americans have devoted more time to a study of Isthmian Canal projects than Gen. Henry L. Abbot. As a member of the technical committee of the New Panama Canal Co. and later as its consulting engineer, he was in a position to acquire all the data concerning the project of that company, which it had acquired as the successor of the original company and by its own investigations. These data are freely used in his book, "Problems of the Panama Canal," published by The Macmillan Co., New York. The author's opinions are well summed up in his final paragraph: "It is the unanimous opinion of all the engineers who have had practical experience in canal work and time to thoroughly study the problem that no sea-level project without locks and no sea-level canal even with a tidal lock, is practicable that would be comparable in ease and safety of transit to one equipped with modern locks and planned to take advantage of all the desirable elements which the natural conditions offer." The book contains a large amount of information concerning the climatology of the Isthmus, the Chagres river and the Culebra cut, and while it bears throughout the style of an ex-parte discussion of a disputed question, its value as a contribution to the literature of this great national undertaking is very high.

Two trade publications have recently appeared which are of such unusual interest that they merit special notice among those books issued by regular publishing houses. The first is a beautifully printed volume entitled "The Westinghouse Companies in the Railway and Industrial Fields," and was prepared for distribution among the delegates to the International Railway Congress. Its permanent importance lies in the excellent view it gives of the great industries which have been organized by Mr. George Westinghouse. Few people appreciate that this one man has probably been the greatest captain of manufacturing industry the world has ever seen. By means of the air brake and the automatic signal he has made railroad traffic safe at high speeds and with frequent trains, he was the pioneer advocate and developer of alternating current electrical apparatus in this country, he founded one of the greatest steam and gas engine works in the world and personally made many important improvements in these prime movers, and has been the leading spirit in many other enterprises. This book gives an excellent idea of the leading companies of which Mr. Westinghouse is the active head, outlines their development and explains the important features of their products. For this reason it ought to be preserved in every public library having a collection of technical literature, for it is a record of international industrial achievement of which the country may very well be proud. Copies of the book can doubtless be obtained from the Westinghouse Companies' Publishing Department, East Pittsburg, Pa. The second trade publication which merits review here is entitled "Stirling: a Book on Steam for Engineers," and has been compiled by the engineering staff of The Stirling Co., New York. About one-sixth of its contents are devoted to a discussion of fire-tube and water-tube boilers and an explanation of the merits of the Stirling type, leaving about 200 pages for a compilation of data on heat, air, water, impurities in boiler feed-water, heating boiler feed-water, steam, moisture in steam, flow of steam through pipes and artifices, superheating, combustion, fuels for steam boilers, determination of heating value of fuels, fuel burning, chain grates, utilization of waste heat, chimneys and draft, analysis of flue-gases, steam boiler efficiency, boiler rating, rules for boiler testing, results of tests of Stirling boilers, boilers for marine service, principles of steam piping, coverings for boilers and piping, cleaning and management of boilers. It must be remembered that the engineers who compiled the information under these topics collected it originally for their own daily use, have tried its value in the extensive and varied problems presented to The Stirling Co. for solution, and have presented it in compact form with an excellent index, so that the book is an excellent manual for the designer of a boiler plant.

An Introduction to the Modern Theory of Equations. By Florian Cajori. New York, The Macmillan Co.; cloth, 16mo, 250 pp.; $1.75.

There are a good many engineers whose college work in mathematics was sufficiently rational and scientific to interest them deeply in this subject. No technical course can do very much with those mathematical subjects not useful to the engineer; in fact, their introduction in such a course is a mistake; but the engineering college that lets its students out into the world without a liking for mathematics is defective in its teaching methods, and fortunately this fact was so well recognized long ago that there has been a constant improvement in the quality of the instruction in this subject. Among the interesting branches which need not be taught in technical courses but are full of interest to those who appreciate the beauty of mathematical logic is the modern theory of equations. It has occupied the attention of master minds like Gauss, Abel, Klein, Galois and other specialists, and a great deal that has been written concerning it is so advanced in character that it can be read only with an expenditure of more time than the average engineer can devote to it. The main features of the subject, even the Galois theory of equations, can be readily understood if properly presented, and this has been done by Professor Cajori. He has omitted any discussion of invariants and covariants, but gives unusual space to substitutions, substitution-groups and the domains of rationality. This change in the usual character of presentation of the subject extends the scope of the book somewhat at the expense of silence on a topic of considerable general interest. Engineers who have occasion to perform much algebraic work of an advanced nature will find this book unusually clear and practical owing to the numerous examples it contains. It is as hopeless to study mathematics without practice in solving problems as to attempt to master chemistry without work in a laboratory.

General Statutes Relating to the Use of Streets and Highways. By James S. Cummings. Chicago, H. M. Byllesby & Co., 8vo, 268 pp.

The author of this book, who is general counsel for the well-known engineering firm of H. M. Byllesby & Co., has had for fifteen years an extensive practice connected with the incorporation of public service companies and questions regarding their franchise rights. He bears witness to the great waste of time and money that arises through ignorance of the different state and territorial laws on the subject, and has prepared this volume to afford in compact form arranged for ready reference a digest of all the laws governing such topics in this country. The book fills a decidedly important place in business literature and has been admirably compiled.

Calcareous Cements. Their Nature, Manufacture and Uses. By Gilbert R. Redgrave and Charles Spackman. London, Chas. Griffin & Co.; Philadelphia, J. B. Lippincott Co.; cloth, 8vo, 326 pp.

The first edition of this book long enjoyed the distinction of being the only comprehensive book in the English language on the manufacture and properties of cements, apart from their application in engineering works. When it was written, however, Portland cement was made almost exclusively in dome kilns and fine grinding as understood to-day was not thought of. The wet process was employed everywhere except in a few American mills. In the ten years or more that have elapsed since the first edition was published, the industry has been revolutionized. The rotary kiln fired with powdered coal has come into international use, new grinding machinery has been developed, and the chemical technology of the industry has been greatly improved. Accordingly, the book had to be rewritten, and is now practically a new treatise.

It is a well-balanced discussion of the history of the industry, its chemistry, the manufacturing processes followed, and the testing of the product. All these subjects except the first still present many disputed questions. Methods of analysis of raw materials and product are the subject of considerable controversy, the merits of much of the new machinery are warmly debated by both its builders and users, while the great engineering organizations are still at work on cement specifications and rules for cement testing. Hence, it is manifestly impracticable to write a book covering the whole industry which will not controvert the opinions of a good many people interested in it. The great merit of this volume is its fairness; the authors have preserved an unprejudiced habit of thought in the midst of controversy, and are free from any leaning toward distinctively British practices. A book on an industry developing so rapidly as this cannot easily be kept up to date, particularly where an ocean separates its authors from the American plants where every year brings important novelties. Consequently some of the latest developments in this country are not reported in the book, but it is entirely satisfactory so far as it goes.

Letters to the Editor.

Foreign-Built Dredges.

Sir:—Our attention has been called to a statement in your issue of March 11, in which you describe the work of raising the grade of the city of Galveston and call atention to the fact that all the dredges used in this work were built abroad, as no ship-building company here had built or could guarantee such craft. You state that as the methods used in their construction were unknown in American shipyards the risk had to be assumed of bringing them from Europe. As one of these dredges went to pieces at sea with the loss of 16 lives owing to its being unseaworthy, we think that such methods of construction would not be knowingly followed in this country, and we are building and can build dredges that are superior to any built abroad.

Most of the shipyards have not had the special experience in the design of different types of dredging machines, but that their construction facilities are adequate for anything that may be called for is undoubted. There are, however, engineers who have the requisite experience to design such craft, and this company stands prepared to design and furnish dredging machines of any type, up to the largest size, and to suit any practicable conditions and to furnish the same complete under steam in any part of the world.

Yours very truly, Atlantic Equipment Co.
New York, May 16.

[The statement referred to does not imply that such dredges cannot be made in this country. The contractor for the Galveston work informed this journal that when the fleet was purchased only foreign builders had constructed plant having the details he wished and that only such builders could give him the guarantees he demanded. There was nothing in the article implying that dredges with other details which he did not desire, or even with such details could not be built here].

Economical Pipe Sizes.

Sir:—In the article on "Economical Sizes for Cast-Iron Force Mains" appearing in the Record of May 13, there are two typographical errors which obscure the reasoning. The equation for the expense of laying pipe should be

$$x^n = p \ (y-q) \text{ instead of}$$
$$y = abfv^2Q \div 2 \ gx.$$

Also, P and p refer to the same quantity.

Yours truly, W. L. Butcher.
Cambridge, Mass.

[These errors illustrate the perversity of type. The proof of this article was read four times and in making the corrections the enterprising compositor introduced new errors each time. The final corrections were made while the paper was going to press, and in spite of the care of the printers the errors noted slipped in.]

A Steel Pipe Line, 2.5 ft. in diameter and 363 miles long, has recently been completed in Australia from Fremantle to the Coolgardie gold fields, which, according to the "Engineer," cost nearly $13,286,000.

CURRENT NEWS SUPPLEMENT

MAY 27, 1905.

DIRECTORY OF NATIONAL TECHNICAL SOCIETIES.

American Society of Civil Engineers. Secretary, Chas. Warren Hunt, 220 West 57th St., New York. Annual convention, Cleveland, June 20-23. Next meeting, June 7, papers on reinforced concrete arches and on domes.

American Society of Mechanical Engineers. Secretary, F. R. Hutton, 12 West 31st St., New York. Annual meeting, Scranton, June 6-9.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, 95 Liberty St., New York. Annual convention, Asheville, N. C., June 19-23.

National Fire Protection Association. Secretary, W. H. Merrill, Jr., Chicago.

American Institute of Mining Engineers. Secretary, R. W. Raymond, 99 John St., New York.

American Institute of Architects. Secretary, Glenn Brown, Washington, D. C.

Association of Engineering Societies. Secretary, Frederick Brooks, 31 Milk Street, Boston, Mass.

American Society of Heating and Ventilating Engineers. Secretary, W. M. Mackay, 235 Water St., New York. Annual meeting, Chicago, July 7 and 8.

Canadian Society of Civil Engineers. Secretary, Clement H. McLeod, 877 Dorchester St. Montreal.

Society for the Promotion of Engineering Education. Secretary, Prof. M. S. Ketchum, University of Colorado, Boulder, Colo.

American Society for Testing Materials. Secretary, Prof. Edgar Marburg, University of Pennsylvania, Philadelphia, Pa. Annual meeting, Atlantic City, June 29-July 1.

American Society of Municipal Improvements. Secretary, George W. Tillson, Room 12, Municipal Building, Brooklyn, N. Y. Annual meeting, Sept. 5-9, Montreal.

Association of Railway Superintendents of Bridges and Buildings. Secretary, S. F. Paterson, Concord, N. H.

American Railway Engineering and Maintenance of Way Association. Secretary, L. C. Fritch, 1562 Monadnock Block, Chicago.

American Water-Works Association. Secretary, J. M. Diven, Charleston, S. C.

American Foundrymen's Association. Secretary, Richard Moldenke, P. O. Box 432, New York.

Engine Builders' Association of the United States. Secretary, J. L. Lyle, 39 Cortlandt St., New York.

American Public Works Association. Secretary, W. H. Flint, Chattanooga. Annual meeting, Chattanooga, Aug. 30-31.

THE LITTLE JAP HAMMER DRILL.

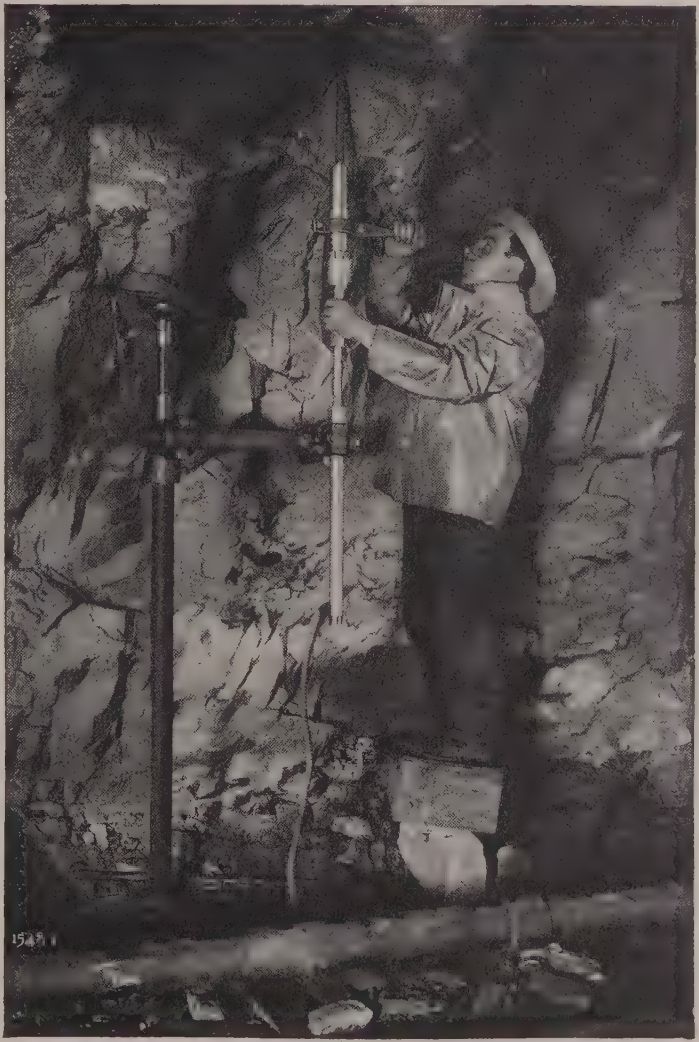
A recent addition to the rock drilling appliances built by the Ingersoll-Sergeant Drill Co., is the Little Jap hammer drill.. While the ordinary piston drill, built for more than 35 years by this same company, is a development of the original churn drill in which the steel was plunged back and forth against the rock, the "Little Jap" is an application of the totally different principle of hand drilling, in which the steel remains against the rock and is struck repeated blows by a rapidly moving hammer.

The new drill is distinguished by the use of the Haesler axial valve. This has a movement around a fixed axis, the travel in opening and closing the air ports being caused by the difference between a constant pressure on the short wing, and an intermittent pressure on the long wing of the valve. Valve, valve box, cylinder and hammer are of special steel; the latter hardened and ground to a plug fit. The shank of the steel slips freely into a hexagonal opening in the front cylinder bushing and is struck by the hammer in its travel. Except with the style of the Little Jap known as the No. 1, hollow steels are used and a portion of the exhaust from the drill passes through the steel, blowing out the chips and clearing the hole in front of the bit. A collar is mounted on the cylinder through which a part of the air is discharged against the mouth of the hole, throwing the chips to the side instead of outward.

The two machines last described are equally adapted for hard, medium or soft rock, their performance of course depending upon the character encountered. Their drilling capacity is a hole of diameter up to 1½ in. to a depth of 48 in. A 1¼ in. hole can be drilled in hard granite or quartz at the rate of 4 to 5 in. per minute with these machines. In sandstone, limestone and similar soft material a rate of 8 to 10 in. per minute can be made with a hole of the same size.

The Little Jap hammer is made in three styles, adapting it for various conditions. No. 1 is furnished with a hand grip, a finger throttle valve and a simple, positive, automatic rotating device mounted on the front head. This machine uses solid steels and is intended for the very lightest work, such as drilling pop and wedge holes in mine and quarry. Its recommended performance is a ¾-in. hole drilled to a depth of 6 in.; but holes of greater depth and diameter can be drilled with it. In the hardest granite a ¾-in. hole can be drilled to a depth of 3 in. in 15 to 25 seconds. It may be operated in either horizontal or vertical positions.

The No. 2 Little Jap has a hand grip also; but instead of an automatic rotating device, a hand lever is mounted about midway of the cylinder. In operation the handle is grasped in one hand and the rotating lever in the other. The drill is forced forward with the bit against the rock, when the valve is opened by the finger and the lever swung back and forth, rotating the entire tool through a portion of a circle and producing a round hole.



THE LITTLE JAP DRILL, WITH AIR FEED, IN OPERATION IN THE PENNSYLVANIA RAILROAD TUNNEL UNDER THE EAST RIVER.

In the No. 3 Little Jap, the hand grip is replaced by a back head mounted on the plunger of a long pneumatic cylinder. This cylinder is clamped on a tunnel column, shaft bar or tripod; and air admitted behind the plunger forces the drill and steel forward against the rock and holds it there as the hole deepens. The total travel of the plunger is 16 in., and the complete device constitutes the automatic pneumatic feed.

The two machines last described are equally adapted for hard, medium or soft rock, their performance of course depending upon the character of material encountered. Their drilling capacity is a hole of diameter up to 1½ in. to a depth of 48 in. A 1¼-in. hole can be drilled in hard granite or quartz at the rate of 4 to 5 in. per minute with these machines. In sandstone, limestone and similar soft material a rate of 8 to 10 in. per minute can be made with a hole of the same size.

THE NEW WARREN STEAM TURBINE.

Announcement was made in the Sept. 3, 1904, issue of The Engineering Record of the development of the Crocker steam turbine by the Warren Electric Co., Sandusky, O. While experimental work has been under way upon the new turbine for upward of two years it is only recently that the company has undertaken to build turbines for the market, the experimental work having been carried out with unusual thoroughness and care. The company has, however, completed several machines, and is now building two 1,000-kw. turbo-alternator sets for the Boston Navy Yard.

This turbine operates upon the longitudinal flow principle, the steam expanding rapidly in an initial elliptical nozzle down to a pressure of 4 or 5 lbs., whereupon it impinges upon the first set of rotating blades; it is then received by a set of stationary blades or guide spaces, where it expands further and acquires additional velocity to impinge upon the second set of rotating blades, this process continuing until four sets of rotating blades have been acted upon and passed. The turbine is of the horizontal type and resembles the Parsons turbine somewhat in general features of construction, although modifications are introduced which obviate largely the end thrust upon the shaft due to steam pressure.

The rotating members are of steel discs mounted close together upon the main shaft, so as to alternate at the periphery with the guide blade rings. The blades are of drop-forged steel and are dovetailed into the peripheries of the steel discs; the blades grow gradually larger in size on the discs farther from the nozzles, which thus provide the greater flow area necessary for the expansion. The discs are enclosed closely at the edges and sides by the casing with very little clearance, and the casing is provided with an annular chamber on either side of the discs, so located as to come in line with the nozzles and line of flow of steam through the blades—these are the steam and exhaust chambers. The nozzles, instead of following usual methods of construction, consist of a series of diverging inclined holes through a bronze ring which separate the steam chamber from the interior of the turbine casing. These holes are machined by a special process in the periphery of a bronze ring, which results in a series of spiral diverging grooves upon its edge; then after facing this grooved edge, it is enclosed by another solid bronze ring which is shrunk over it, so as to close up the grooves on the outside and complete the nozzles. These nozzles are carried entirely around the ring, so that when the turbine is in operation the blades are all full of steam.

Governing is accomplished in the turbines up to 300-kw. capacity by cutting out or opening up one or more of the nozzles, so that partial loads will be handled efficiently. Throttling is thereby avoided except at the particular nozzle the governor may at any time happen to be operating upon, all the rest being either entirely open or shut. The nozzle cutoffs are operated by a centrifugal governor driven from the turbine shaft, which operates the nozzle cut-off ring in the steam chamber through the agency of a small steam cylinder outside the turbine casing. The cut-off ring is held against the inlet face of the bronze nozzle ring, having holes in it of different lengths, whereby any movement of the ring cuts on or off nozzles according to the direction of its movement. The regulation obtained is so close that 2 per cent. is guaranteed. While the same principle of governing is used for the larger turbines, it is differently applied in that the steam chamber is divided into sections and the steam supply is cut off or on one or more of the sections by the centrifugal governor in regulating their speed.

The details of the turbine have been carefully worked out. As almost all of the expansion of the steam takes place in the nozzles their shape received a great amount of study and investigation in order to obtain the highest degree of efficiency in operation; the angularity or direction of flow in the nozzle is on an elliptical curve, this being thought to be the ideal direction of steam expansion in the turbine. The blades and guide vanes were so shaped and proportioned that the reaction of the steam shall counterbalance the end thrust due to the difference of pressure between the first set of buckets and the exhaust end of the turbine. The amount of unbalanced thrust as a result of this construction is very small and can easily be taken care of by the thrust bearing. Forced lubrication is used upon all the bearings, although no oil is allowed to enter the steam spaces to contaminate the exhaust. The amount of space occupied, as well as also the weight, per kilowatt of turbine capacity is claimed to be unusually low.

THE ANTI PLUVIUS SKYLIGHT.

This skylight is comparatively new in the United States, but is extensively used in Europe, where some large installations were recently built or are now being constructed under this system. It is the invention of a skylight builder in Germany, and naturally the greatest amount of work with it has been done there. At the present time the new railway station at Hamburg, among the largest in the world, is being equipped with this skylight, which was specified by the managers of the Prussian State Railway after three other large stations of their road had been fitted with it and tested. A part of the skylight on the Hamburg station is peculiarly arched. By an ingenious arrangement of flat glass plates and flat steel supporting bars an effect of curved or bent plates and bars is attained. Nothing but wire glass is used for the skylight of the Hamburg station, and in fact for all stations now being built by the Prussian State Railway.

The construction of the Anti-Pluvius system of skylighting is as follows: The steel supporting bar A is U-shaped, giving a maximum strength with minimum of weight. The small wedge-shaped cast-steel bridge fitting into the U-shaped bar carries the weight of the skylight, and for that reason fits firmly into the bar in such a way that its lower ends rest on the bottom of the channel, while its sides are held firmly.

On these bridges rests an ⅛-in. flat iron strip C, 1½ in. wide, and on top of the flat-iron is a strip of felt of the same width. On this felt rests the glass E. Thus the glass is raised about half an inch above the upper edge of the U-shaped channel so that the inside of the latter channel is open and freely exposed to the atmosphere under the skylight and is therefore of the same temperature. This makes the channel proof against the formation of sweat drops and against the dropping of condensation into the space beneath. The raising of the glass above the channel also enables whatever condensation may form on the lower side of the glass to be easily conducted into the channel, which serves as a gutter for its removal.

After the glass is laid on the strip of felt, another strip of felt is placed on the upper side of the glass. On top of this felt is fitted a cap of copper sheeting. The spring fits around an upright brass bolt, which is screwed firmly into the bridge. The top of this bolt is threaded in such a way that it carries a quarter inch shoulder; on this shoulder rests the bridge J, to carry the weight of people walking on the skylight. As the bolt on which this bridge rests is screwed into the little bridge B, the weight of any one walking on the skylight never comes on the glass at all, but is borne directly by the supporting bars, A, below the glass. The glass rests in such a way that the steel supporting bars could be bent two or three inches without bending the glass. There is therefore no danger of breakage from walking on the skylight.

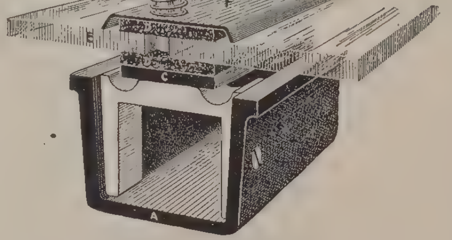
The whole system allows play for any movement of the glass, whether from contraction and expansion, vibration shock or other motion. The glass is held firmly in place, but without putty or cement. The felt and copper sheeting, held down firmly by the spiral spring, makes the skylight proof against rain, dust and draught. In heavy rain water may percolate under the copper sheeting, through the felt and two adjoining lights, but can then drop only into the U-shaped channel, which acts also as a gutter.

Any of the glass plates may be removed quickly by unscrewing two brass nuts above bridge, J; a light can be taken out and another put in its place in a few minutes.

The Anti-Pluvius system, as now perfected, has been in use for four years, and nearly three million square feet of such skylighting have been constructed, according to the American Machinery Co., 17 Battery Place, New York, which owns the patent rights in the United States, and has a special department devoted to the construction of the skylights.

TRADE PUBLICATIONS.

The Borden & Selleck Co., 48-50 Lake St., Chicago, describes, in its booklet No. 8, the Harrison coal conveyors and elevating machinery. There are several views of coal pockets in which this machinery has been installed.



THE ANTI-PLUVIUS SKYLIGHT.

The recent catalogue of Ludlow gate valves for steam, water and gas mains, Ludlow hydrants, water works equipment, and the cast-iron street drainage and pipeline supplies manufactured by the Pittsburg Mfg. Co., Pittsburg, Pa., also contains several pages of tables and formulas which will be found useful in designing or estimating work in which these specialties are employed.

The catalogue of the Chicago Bridge & Iron Works, Throop and 105th Sts., Chicago, gives a number of full-page illustrations of the special and standard designs of elevated water tanks that have been fabricated in these works. Steel chimneys, bridges and the general line of heavy plate work which are also produced in the works are briefly described and several pages of tables of value in investigating work of this character are included.

Fire brick and sewer pipes are made in a great variety of patterns and sizes by the Evens & Howard Fire Brick Co., St. Louis. A well-illustrated description of these products is given in the new catalogue of the company, which also illustrates glazed clay conduit pipe for steam and hot-water mains, back-water valves, architectural specialties and ironstone paving blocks for floors of industrial plants.

An interesting description of the method of producing in the electric furnace the chemically pure graphite used as a pigment in Acheson graphite paint is given in an artistic pamphlet recently issued by the International Acheson Graphite Co., Niagara Falls, N. Y. The description treats of the ideal protective coating for structural steel and the recent advances that have been made in the manufacture of paint to provide such a coating.

"Compressed Facts About Compressed Air" is the title of a booklet by the Clayton Air Compressor Works, of 114 Liberty St., New York, giving a résumé of the points to be considered in buying an air compressor of medium capacity. An introductory quotation from Andrew Carnegie, that "a small saving in each process means fortune," introduces brief chapters on economy of compressed air, features of a money-saving air compressor, how these features are combined in a good and medium-priced machine, method of driving air compressors, and some of the uses of compressed air. Under the last head are enumerated 139 distinct applications of compressed air and the list is by no means exhaustive.

The 1905 catalogue of the American Valve Co., Coxsackie, N. Y., contains brief illustrated descriptions of the special and standard valves manufactured by this company, with tables of the sizes of the different types. The feature of these valves is a sort of roller bearing between the disks, which are of the wedge pattern. This enables the valves to be opened easily and also permits the disks to be forced tightly against their seats.

The Allfree-Hubbell system of steam distribution, as applied to various types of locomotives operating on different American railway systems, is described in detail in catalogue No. 7 of the Locomotive Appliance Co., Chemical Bldg., St. Louis, Mo. The pamphlet also includes reproductions of several indicator diagrams and of pictures of engines on which the diagrams were made.

A useful handbook of cement and concrete data has been published by the Kosmos Portland Cement Co., Todd Bldg., Louisville. The contents include the specifications drawn up by the Board of Engineer Officers, U. S. A., the report of the committee on standard specifications for cement of the American Society for Testing Materials, extracts from Capt. J. S. Sewell's report on the fireproof qualities of concrete used in the buildings exposed to fire at Baltimore, an abstract of the report of the committee on uniform tests of cement of the American Society of Civil Engineers, and hints for making concrete for various purposes. The company's works at Kosmosville, Ky., are briefly described and analyses of the oolitic limestone and clay used in making the cement are given.

A series of excellent engravings, 46 in number, of locomotive shop tools, has been published in the April "Progress Reporter" of the Niles-Bement-Pond Co., 136 Liberty St., New York. These illustrations probably give a better idea of the methods of manufacture followed in the Schenectady works of the American Locomotive Co. than could be obtained in any other manner. They show how the boilers, cylinders, frames, wheels, rods and other parts are made by reproductions of photographs of these machines in service. The illustrations are accompanied as a rule by statements of the speed and depth of cut, both roughing and finishing. Anybody interested in modern machine shop methods will find these engravings of more than usual interest.

The Electrical Testing Laboratories, 550 East 80th St., New York, have published in pamphlet form a description of their equipment and facilities. They have also issued a discussion of the use of incandescent electric lamps as standards of candle power. This describes methods of preparation and the proper use of standard lamps, a special lamp for photometric work, and an accurate portable potentiometer which may be used in connection with seasoned and standardized incandescent lamps for accurately checking direct-current ammeters.

A well-illustrated description of watertube boilers has been prepared by the E. Keeler Co., of Williamsport, Pa., for its new catalogue. In addition to an explanation of the merits of the design of the various details of such apparatus, there is considerable information on special furnaces for burning lignite, bagasse, rice hulls, oil and gas, and also concerning the Metesser superheater.

The Contractors' Tool Co., 704 Arch St., Philadelphia, has prepared a catalogue of tools and supplies used particularly by cement workers. The experience gained in the recent rapid development of concrete construction has shown the importance of tools made specially for such work, and these implements form the subject of this catalogue.

Contractors for pipe lines and water-works superintendents will find in a small "Green Book" issued by Mr. J. Edward Ogden, a useful, descriptive list of lead furnaces, pots, ladles, asbestos joint runners, sewer braces and other pipe-line supplies.

The American Asphaltum & Rubber Co., Woman's Temple, Chicago, has published "Noiseless and Sanitary Pavements," a discussion of the merits of different types of joint filler. Extracts from various papers before engineering societies and from letters by engineers and contractors are given in corroboration of the company's claims for its Pioneer filler.

The type K multiphase induction integrating wattmeters made by the Fort Wayne Electric Works, Fort Wayne, Ind., are descibed in a new bulletin. The single-phase instruments of this type are well known and the multiphase wattmeter is made on the same general principles.

Catalogue P of the Carson Trench Machine Co., Boston, Mass., is a picture book of work done in many parts of the country with the company's cableways, conveyors and trench machines. The hints for arranging plant that are given in many of these pictures ought to be valuable to contractors.

PERSONAL NOTES.

Hon. C. S. Hyman has been appointed minister of public works of Canada.

Mr. Holland Wheeler has been appointed city engineer of Lawrence, Kan.

Mr. Edwin M. Davis, formerly secretary of the Niles-Bement-Pond Co., died at his home in New York, May 17.

Mr. R. H. Canfield has been appointed superintendent of public works in Corning, N. Y.

Captain Sherwood A. Cheney, Corps of Engineers, U. S. A., has been assigned as chief engineer of the northern division.

First Lieutenant Ernest D. Peek, Corps of Engineers, U. S. A., has been transferred from the Second Battalion of Engineers to Cincinnati, O.

Mr. Chas. E. Bright, formerly resident engineer on the Dossett tunnel on the Louisville & Nashville Ry., is now resident engineer of the Tidewater Ry., at Roanoke, Va.

Mr. Myron S. Falk, instructor in civil engineering at Columbia University, has opened an office for general civil engineering practice at 60 Wall Street, New York City.

Mr. John Gavey, C. B., engineer-in-chief of the technical department of the British Post Office, has been elected president of the Institution of Electrical Engineers.

Major John W. Johnston, who was formerly engaged in the construction of the Georgia Pacific Ry., now a part of the Southern Ry., from Atlanta, Ga., to Birmingham, Ala., died in Richmond, Va., May 21.

Mr. Harry B. Alderson has been appointed sanitary engineer for the Mexican Construction & Engineering Co., and will be in charge of the construction of a sewerage system at Puebla, Mex.

Wireless telegraphy has worked on the public imagination seriously enough to turn out a crop of wireless cranks. One of them recently had summons issued for Professors Pupin and Chandler, of Columbia. He said in court: "One night I was so badly pummeled in bed that I couldn't get up next day. I had no idea who was assaulting me until I got a wireless message telling me it was Professors Pupin and Chandler. I never met these gentlemen, but I want them to deny it in court." The case was dismissed.

The following engineers have been announced by the War Department to have been appointed consulting engineers to the Isthmian Canal Commission, in addition to those previously appointed: Mr. Isham Randolph, chief engineer of the Sanitary Drainage District at Chicago; Brigadier-General Henry L. Abbot, Corps of Engineers, U. S. A., retired; Major-General George W. Davis, U. S. A., retired, and Mr. Herman Schussler, chief engineer of the Spring Valley Water Works at San Francisco, Cal.

Mr. H. J. Slifer has become associated with J. G. White & Co., of New York, as steam railway expert. Mr. Slifer graduated from the Polytechnic College of Pennsylvania in 1880 and has been engaged in railroad engineering work continuously since them. He was engaged in various engineering capacities with different railroads in the United States and Mexico until he became superintendent of the Iowa division of the Chicago & Northwestern Ry. in 1899. He resigned from that position in 1902 to become general superintendent of the Chicago, Rock Island & Pacific R. R., in charge of operation, motive power and maintenance between Chicago and Denver.

Mr. David J. Smyth, director of public safety, and Dr. P. E. Costello, director of public works, of Philadelphia, have been summarily removed from office by Mayor Weaver, in order to enable him to appoint to these offices people "responsible only to the Mayor and to the city." These removals are due to the refusal of the two directors to assist the Mayor in his fight against the extension of the lease of the city's gas works to the United Gas Improvement Co. at terms strongly opposed by the leading taxpayers of Philadelphia. The advocates of the lease claim that the city needs the money it will render available for necessary public improvements. The opponents of the lease assert that the proposed payment is ridiculously small and the character of some of the recently constructed works deserves investigation.

The Bessemer Medal of the Iron and Steel Institute was awarded this year to Professor J. O. Arnold, of Sheffield University College. He has turned it over to the technical department for reasons he explains as follows in a letter to Sir Frederick Mappin: "If you and your committee had not induced the City Council to provide the practical plant by means of which the researches for which the medal was awarded were alone possible, the medal would not have come to Sheffield for the year 1905. Also, the hard work and devotion of my staff for the last fifteen years deserve the highest commendation; and last, but not least, I must call your attention to the whole-hearted and unselfish manner in which Professor Ripper has supported the metallurgical department. In these circumstances I feel that the medal belongs to Sheffield in general and to the technical department in particular."

CONTRACTING NEWS

OF SPECIAL INTEREST TO
CONTRACTORS, BUILDERS, ENGINEERS AND MANUFACTURERS
OF ENGINEERING AND BUILDING SUPPLIES.

WATER.

Notes Arranged Alphabetically by States.

Anaheim, Cal.—The Ideal Water Co. is reported incorporated with a capital of $3,000, to develop a flow of 150 inches by pumping. The ranches will be connected by a number of cement ditches. Stockholders: H. D. Young, Jas. McCorkindale, Chas. Ellis and others.

Riverside, Cal.—See "Schools."

Haywards, Cal.—Hunt Bros. owners of the canneries here, are stated to have decided to construct a cement reservoir capable of holding at least 50,000 gal. and will also install new pumping machinery, etc., for a water supply.

Wilmington, Del.—Bids will be received on June 5 by the Bd. of Water Comrs. (Theo. A. Leisen, Ch. Engr.) for a 12,000,000-gal. vertical triple-expansion pumping engine, as advertised in The Engineering Record.

Washington, D. C.—The Secy. of the Interior is reported to have set aside $1,000,000 to be used in connection with the Klamath irrigation project in California and Oregon. It is estimated that 236,000 acres will be reclaimed.

Washington, D. C.—Plans and specifications are on file at the office of The Engineering Record, 114 Liberty St., for the following irrigation projects, prepared by the U. S. Reclamation Service: Pathfinder dam and auxiliary works, North Platte, Wyo., project, bids to be opened at Denver, Colo., June 15; canal, pumping station, bridge, etc., Huntley project, bids opened at Billings, Mont., June 28; canal, telephone system, etc., Ft. Buford project, N. D. and Mont., bids opened June 1, and at Glendive, Mont.; canals, pole line and telephone system, Minidoka project, bids opened at Boise, Idaho, June 15 and for the outlet and controlling works the bridge, Truckee-Carson project, Nev., bids opened at Hazen, Nev., June 15.

Bids will be received June 10 by the Comrs., D. C., (Henry B. McFarland, Chmn.) for furnishing granite curbing, asphalt blocks, red sewer bricks, sand and gravel, terra cotta sewer pipe and branches, vitr. sewer invert blocks and repressed vitr. sewer invert bricks, vitr. pav-

Eau Gallie, Fla.—Wm. R. Roesch, Pres. Bd. of Aldermen, writes that it is proposed to install a system of artesian wells connected directly to the mains, the wells to have a pressure of about 17 lbs. on surface.

Reynolds Ga.—Ricks Bros., owners of the flour mill, are reported to be investigating cost of establishing water works to supply the town.

Montpelier, Idaho.—Bids will be received until June 10 at the Montpelier Irrigation Dist. (W. J. Hunter, Pres.), at Montpelier, for furnishing material and completing the grading, masonry, flumes, bridges, waste gates, etc., of the Montpelier Irrigation Canal, as advertised in The Engineering Record.

Chicago Ill.—City Engr. John Ericson is stated to have submitted to Jos. M. Patterson, Comr. of Pub. Wks., a report on the water system of the city. He estimates that in addition to improvements already in contemplation and under way, estimated at a cost of $4340,000, which will suffice until 1909, a further expenditure of $5,080,000 is necessary by city to provide for a population of 3,300,000, which it is estimated will be reached in 1919. A strong argument for the installation of water meters to prevent waste is made by the city engineer, and it is suggested that pitometers would aid.

Kewanna, Ind.—The Kewanna Water Co. is reported formed with a capital of $15,000, to construct water works. Dr. A. Armstrong, Pres.

Onawa, Ia.—C. M. Ross, City Clk., writes that it was voted May 15 to issue $10,000 bonds for the construction of water works. No engineer selected as yet.

**Humboldt, Kan.*—W. W. Cook & Son, of Junction City, have secured the general contract for constructing water works for $35,477 and the Chicago Bridge & Iron Wks., Chicago, Ill., for the tower at $3,648 (bids opened May 3).

Covington, Ky.—Geo. Hornung, 612 Johnston Bldg., Cincinnati, O., has completed and presented to this city a report on the most feasible plan to protect the city of Covington from an impaired water supply, during the periods of failure of its supply main. He has reported on 3 plans suggested. The matter will soon be taken up and one of the plans reported will be adopted.

Baton Rouge, La.—The citizens are reported to have voted May 16 to issue $300,000 bonds for constructing water works, erecting a school, paving the streets and for other municipal improvements.

McDonoghville, La.—As soon as the charter is recorded, which will be in about a month, plans will be prepared for water works, to cost about $50,000. Engineer, H. L. Zander, 1125 Dumaine St., New Orleans. The Citizens Improv. Assoc., of which Henry Hart is Pres. and Theo. Landry is secy., is interested.

**Boston, Mass.*—The following are the bids opened on May 10 by the Metropolitan Water and Sewerage Bd. for improving about 30 acres of the Wachusett Reservoir in West Boylston and Sterling: McBride & Co., Brighton, $25,461 (awarded contract); Rowe & Perini, So. Framingham, $25,500; Auguste Saucier, So. Framingham, $27,500; Nawn & Brock, Roxbury, $27,670; Boylston Cons. Co., W. Boylston, $29,570; Newell & Snowling Cons. Co., Uxbridge, $32,360; Booth & Co. (Inc.), Boston, $50,250, and Joseph B. O'Rourke, South Boston, $60,300. The detail bid of McBride & Co., the successful bidders, is as follows: 20 acres clearing and grubbing, $53; 109,000 cu. yds. earth excav., 19⅞ cts.; 800 cu .yds. paving, $2.25, and 150,000 cu. yds. overhaul, ⅝ cts.

Southbridge, Mass.—Bids will be received until June 6 at the office of the Southbridge Water Supply Co., Southbridge, for constructing 2 storage reservoir dams on Hatchett Brook; Moore & Smith, Engrs., 44 Front St., Worcester.

Middleboro, Mass.—Engr. F. T. Fuller, of Boston, is stated to have recommended that a new standpipe 40 ft. diam. and 125 ft. high be erected on Barden Hill, that hydrants be added and that the 8-in. main on Wareham St. be replaced with 12-in pipe, at a total cost of $33,600.

Battle Creek, Mich.—The Bd. of Pub. Wks. is reported to have under consideration the question of securing a new water supply.

Whitehall, Mich.—The Council is stated to have decided to purchase pumping machinery for the water works.

Kalamazoo, Mich.—The Grand Rapids & Indiana Ry. Co. (E. H. Barnes, Engr., Grand Rapids) is reported to be planning to expend $20,000 for a water supply.

Duluth, Minn.—City Engr. McGilvray is stated to have commenced preparing plans and specifications for a 10,000,000-gal. reservoir, to be constructed in Lloyd's Addition, West Duluth.

St. Paul, Minn.—It is stated that bids are wanted until June 5 by the Co. Comrs. for deepening well No. 2 at White Bear Lake and for the removal and replacement of roof, floor and pump at present in use, and such other work as may be necessary in connection therewith. Edw. G. Krahmer, Co. Aud.

Winona, Minn.—The city expects to change the arrangement of its water station and will be in the market in the near future for boilers. G. P. Coleman, City Engr.

Harmony, Minn.—It is reported that bids will be received by H. C. Horsend, Village Recorder, until June 2, for furnishing materials and laying c. i. pipes and specials for extension of the water mains.

Nashwauk, Minn.—Bids will be received until June 5 by the Village Council for furnishing materials and constructing water works, to consist of laying about 1,500 ft. of 8-in., 3,700 ft. 6-in. c. i. pipe, with specials, and 12 hydrants, excavating a well, setting in place with all steam and water connection two pumps and boilers, erecting a pump house and water tower. Paul H. Toedx, Village Recorder.

**Lumberton, Miss.*—E. J. O'Bierne, of Memphis, Tenn., has secured the contract for constructing water works (bids opened May 17) for $18,843. New bids will be received for the air compressor. Engineer, R. C. Huston, of Laurel; P. E. Williams, City Clk.

Centralia, Mo.—A committee, including C. J. Johnson and J. R. Wiseman, has been appointed to investigate the cost, etc., of water works. An election will probably be held in June to vote on the question. John E. Hinman, Mayor.

**New Madrid, Mo.*—G. Jager, of Rich Hill, has secured the contract for constructing a complete system of water works (bids opened May 17) for $17,945. Engineer, Owen Ford, Security Bldg., St. Louis.

**Havre, Mont.*—C. W. Swearingen, City Engr., writes that the following are the bids opened May 10 for the installation of a system of driven wells to provide a water supply for the city: (*a*) A. C. Edwards (awarded contract); (*b*) P. H. Brader; (*c*) H. W. Gross: (bidders all of Havre.)

	**a*	*b*	*c*
1,800 cu. yds. earth excav. and refill	$0.58	$0.38	$0.75
73 M. ft. lumber	26.50	22.00	23.00
6,300 ft. 2-in. wrought iron pipe	.48	.56	.87
40 ft. 10-in. Standard c. i. pipe	2.50	1.91	3.50
45 ft. 12-in. Standard c. i. pipe	3.15	2.50	4.00
96 8x6x2-in. flanged c. i. tees, 8 ft. long, ea.	15.76	18.75	18.40
48 2-in. well points, brass jacketed, ea.	1.94	2.00	3.50
48 2-in. well points, Morris Perfection, ea.	3.24	2.00	4.25
96 2-in. straightway valves, ea.	2.51	2.66	3.50
96 2-in. flange unions, ea.	.44	.54	.70
2 8x6x12x12-in. c. i. crosses, ea	24.20	40.00	27.60
2 6x6x10x10-in. c. i. crosses, ea.	18.52	38.00	23.80
1 10x12-in. c. i. reducers, ea.	13.98	9.84	15.60
Total	$8,362	$8,450	$11,467

Alma, Neb.—See "Power Plants, Gas and Electricity."

Cambridge, Neb.—Burns & McDonnell, Dwight Bldg., Kansas City, Mo., have been selected to prepare plans for water works. An election to vote on issuing bonds will soon be held.

Orange, N. J.—This city is reported to have in contemplation the construction of a new reservoir in the South Mountain reservation and the building of a new pipe line to the city.

Atlantic City, N. J.—Bids are wanted June 5 for constructing inlets, as advertised in The Engineering Record.

Vineland, N. J.—Bids will be received until June 7 by the Bd. of Mgrs., at the office of C. H. Anderson, 705 Land Title & Trust Bldg., Philadelphia, Pa., for furnishing material and constructing a system of water works at the Home for the Care and Training of Feeble-Minded Women at Vineland, as advertised in The Engineering Record.

Asbury Park, N. J.—Bids will be received by John L. Coffin, Supt. Dept. Water & Sewers, May 29, for furnishing and placing in position 1,290 ft. of 15-in. wrought iron ocean discharge pipe, as advertised in The Engineering Record.

Santa Fe, N. M.—G. A. Collins, Ch. Engr., Sante Fe Irrigation & Development Co. writes that it is proposed to construct an irrigation system to irrigate 10,000 acres, to cost about $150,000.

New York, N. Y.—The Bd. of Estimate is reported to have approved a 10-yr. contract with the New Jersey Water Co., of Jersey City, to furnish water to Staten Island, not to be less than 3,000,000 gal. per day.

Ft. Ontario, N. Y.—The following are the bids opened on May 11 by Capt. W. M. Coulling, Q. M., U. S. A., Oswego, for furnishing material and constructing a water distribution system. Robt. B. Mitchell, N. Y. City, $5,896, E. P. Munger. Fulton, $13,550, John C. Sullivan, Oswego, $9,750, Mosier & Summers, Buffalo, $12,000, DeWitt G. Nash, Albany, $5,845, M. J. Fitzpatrick, Plattsburg, $6,769, Barnett Contr. Co., Oswego, $11,535, John W. Danforth, Buffalo, $8,875 and Edw. P. Bates, Syracuse, $11,500.

West Point, N. Y.—The following are the bids opened on May 11 by the Quartermaster, U. S. M. A., for laying c. 1 pipe, etc., at West Point: (*a*) masonry for intake 40 cu. yds., (*b*) laying 32,000 lin. ft. 20-in. pipe and

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**Items marked thus give the names of parties awarded contracts.*

specials, (*c*) 800 lin. ft. 12 in. c. i. pipe and specials; (*d*) 230 lin. ft. 6 in. c. i. pipe and specials; Castoe & Warner, Bellaire, O., *a*, $6; *b*, *c* and *d*, $1.60; Willouer & Co., Pottstown, Pa., *a*, $6 *b*, *c* and *d*, $1.94; E. A. Matthews, N. Y., *a*, $6; *b*, *c* and *d*, $1.72; Frank Pidgeon, Saugerties, *a*, $5; *b*, $2.49; *c*, $2.75; *d*, $2.50; Albany Material & Constr. Co., Albany, *a*, 7.50; *b*, *c* and *d*, $1.42¼; Chas. Cooke, Poughkeepsie, *a*, $5; *b*, *c* and *d*, $1; Cefalo & Ferguson, Boston, Mass., *a*, $4.25; *b*, 87 cts., *c*, 80 cts; *d*, 50 cts.; Thos. Ed. Mermilye, N. Y. City, *a*, $9, *b*, $1.29, *c*, $2, *d*, $1; Lloyd Collis, Inc., N. Y. City, *a*, $6, *b*, *c* and *d*, 67 cts.; Bellman & Sanford, 149 B'way, N. Y. City, *a*, $14.65, *b*, *c* and *d*, $1.69; Augusto Benvenuti, New London, Conn., *a*, $12.50, *b*, *c* and *d*, $1.62; Thos O'Hern, Yonkers, *a*, $10, b, *c* and *d*, $1.72; Chester A. Dady, Brooklyn, *a*, $5, *b*, $2.47, *c*, $2, *d*, $1; Richards & Gaston, N. Y. City, *a*, $10, *b*, *c* and *d*, $2.25; Robt. E. Mitchell, N. Y. City, *a*, $5, *b*, 79 cts., *c* and *d*, 75 cts; Carl H. Dittmar, N. Y. City, *a*, $9, *b*, $1.80, *c*, $1; *d*, 60 cts.; C. H. Eldridge & Co., Ossining ,*a*, 10, *b*, $1.64, *c*, $1.50, *d*, $1.20; Denniston & Co., Rochester, *a*, $5.50, *b*, $1.60, *c*, $1, *d*, $1; The Abbot-Gamble Co., N. Y. City, *a*, $10, *b*, $2.32, *c*, $1.75, *d*, $1.50; Behan & Cavanaugh, N. Y. City, *a*, $10, *b*, *c* and *d*, $2.17.

*Lieut R. C. Foy, Acting Q. M., U. S. M. A., writes that the contract for furnishing about 3,000 tons of c. i. pipe and special castings (bids opened May 5) has been awarded to the U. S. Cast Iron Pipe & Foundry Co., 903 Land Title Bldg., Philadelphia, Pa., for all 6, 12 and 20-in. bell and spigot pipe, $25.35 per ton of 2,000 lbs. and all bell and spigot special castings, 2.6 cts per lb.

Buffalo, N. Y.—Henry L. Lyon, Deputy Water Comr., writes in regard to water works improvements, that the city contemplates rebuilding present pumping station and erecting 6 new steam pumps 30,000,000 gal ea.; also a new station with 8 centrifugal electric pumps, new tunnel, etc., total cost of work proposed about $2,000,000.

The following are the bids opened May 17 for a centrifugal pump and elecric motor for the pumping station: Allis-Chalmers Co., Milwaukee, $26,600; Buffalo Forge Co., Buffalo, $27,997, and Snow Steam Pump Wks., $30,490.

Brooklyn, N. Y.—Bids will be received until June 7 by John T. Oakley, Comr. Water Supply, Gas and Electricity, New York City, for furnishing and delivering stop-cocks for distribution mains; also for furnishing and delivering c.-i. special castings, all in Boro. Brooklyn.

Minot, N. D.—J. J. Flather, of Minneapolis, Minn., is reported to be preparing plans for water works and a sewerage system.

**Harvey, N. D.*—R. L. Butler, of Stillwater, Minn., is stated to have secured the contract for constructing water works and a sewerage system, for $12,0000.

Lorain, O.—The citizens are reported to have voted May 16 to issue $50,000 bonds for water works improvements, and $3,000 for sewer repairs.

Cleveland, O.—At a meeting of the Council Finance Com., May 15 a committee consisting of C. H. Patton, of the Cleveland Inspection Bureau and Asst. Schultz, of the Water Wks. Dept., was selected to look into the matter and prepare estimates, for the installation of high pressure water service in the congested district of the city.

*The U. S. Cast Iron Pipe & Fdy. Co., of Cleveland, has secured the contract for a supply of c. i. pipe and special castings for the year 1905 (bids opened May 16); contract price reported to be about $97,674.

Cottage Grove, Ore.—The citizens are reported to have voted to issue $20,000 water bonds.

Octoraro, Pa.—The Octoraro Water Co. is reported to have decided to construct a reservoir at Rowlandville, Md.

Slatington, Pa.—The Washington Water Co. is reported organized, with J. W. Balliet, of Slatington, Pres., and Ira A. Seidel, of Lehighton, Secy. The work of laying the main from Statedale to Slatington will begin at once. No pumping engines will be required, as the water supply is a mountain spring.

Woonsocket, R. I.—Bids will be received by the Bd. of Water Comrs. May 29 for a pumping engine of 5,000,000 gal. capacity, as advertised in The Engineering Record.

Aiken, S. C.—The question of securing a new water supply is reported to be under consideration here.

Elkton, S. D.—O. W. Marshall, Town Clk., writes that bids are wanted at once for the construction of water works.

Dallas, Tex.—Bids will be received until June 10 by J. B. Winslett, City Secy., for constructing a wooden conduit 42 in. diam., from terminus of the concrete conduit at the Record Pumping Sta. to a point south 3,400 ft. distant; J. M. Bassett, Ch. Engr. Water Wks.

San Marcos, Tex.—John W. Maxcy, Superv. & Designing Engr., Houston, Tex., writes that preliminary plans have not yet been completed for the construction of an irrigation system in San Marcos; probable cost of work $100,000.

Monroe, Utah.—The City Council is reported to have appointed a committee to procure plans and investigate cost of water works.

Swanton, Vt.—L. A. Sabell, Village Clk., writes that the question of constructing water works is under consideration to draw water from a spring about 8 miles from village. Nothing definite has yet been done. Dr. C. E. Allen, Chmn. Bd. Trus.

St. Johnsbury, Vt.—The matter of constructing water works is in the hands of Trustees C. A. Stanley, F. E. Spaulding and F. S. Harriman, and they are to report at a later meeting.

Wheeling, W. Va.—The Water Bd. is reported to be considering the construction of a new reserve reservoir.

*N. C. Hamilton & Son are stated to have on May 17 secured the contract for constructing a brick boiler house at Slacktown Pumping Station, for $7,000.

Strathcoma, Atla, Canada.—A. C. Rutherford, City Secy. Treas., writes that bids will be received May 29 for the construction of water works and a sewerage system to cost $140,000.

Fernie, B. C.—It is reported that by-laws are being prepared to be submitted to the ratepayers, providing for an issue of $100,000 bonds for water works and a sewerage system. Col. Tracy estimates the cost of water works at $50,000 and a sewerage system at $30,000. J. A. Rennie, City Clk.

Winnipeg, Man.—Bids will be received by the Chairman, Fire, Water and Light Com., June 5, for a supply of water pipe and specials of various sizes for high pressure fire service, and for water meters, as advertised in The Engineering Record.

Puebla, Mex.—Jose Maria Rubin, of Puebla, is reported to have secured a concession to use the water of Cantarranas River for irrigation and motive power purposes; the proposed plant will cost about $200,000.

Regina, N. W. Ter.—See "Power Plants, Gas and Electricity."

Guelph, Ont.—The Water Wks. Com. is stated to have recommended the building of a new filter.

SEWERAGE AND SEWAGE DISPOSAL.

Notes Arranged Alphabetically by States.

Jasper, Ala.—P. Byrne, 1909½ 1st Ave., Birmingham, is making a survey for a sanitary sewerage system for Jasper. A portion of the work will be let by contract, as soon as plans and specifications can be prepared, in about 3 weeks.

Washington, D. C.—See "Power Plants, Gas and Electricity."

Washington, D. C.—The following are the bids opened May 17 for constructing sewers in the Dist. of Columbia: (D. E. McComb, Supt. of Sewers), (bidders all of Washington): Jas. A. Coyle, $29,638; The J. Connelley Co., $25,169; T. H. Louchheim, $27,507; E. G. Gummel, $28,677; Lyons Bros. & Co., $26,140, and John F. Talbert, $25,704.

**Idaho Falls, Idaho.*—The following are the bids opened May 12 by the Sewer Com. for furnishing material and constructing a sewerage system in Local Sewerage Improv. Dist. No. 1: (Engineer, Louis C. Kelsey, Salt Lake City) Handley & Ritchie, Topeka, Kan., $24,362 (awarded contract); Louis C. Kelsey, Salt Lake City, Utah, $25,456; W. W. Cook & Sons, Junction City, Kan., $26,463; McMullen & Keifer, Idaho Falls, $26,536, and Jas. Kennedy, Fargo, N. D., $27,504. The detail bid of Handley & Ritchie, the successful bidders, is as follows: 9,910 cu. yds. earth excav. and backfill, .539 cts.; 410 cu. yds. excav. gravel and boulders, $1.10; 1,810 cu. yds. solid rock excav., $3.69; furnishing anl laying 7,465 lin. ft. 8-in. pipe, 38½ cts.; 1,860 lin ft. 10-in., 49½ cts.; 811 lin ft. 12-in., 55 cts.; 1,493 lin. ft. 15-in., 94 cts.; 2,035 lin ft. 18-in., $1.37; for furnishing and laying Y's, as follows: 320 8x6, $1.02; 84 10x6, $1.37; 28 12x6, $1.92; 49 15x6, $3; 50 18x6, $4.50; for 36 manholes, each $50.60; 22 lin. ft. additional depth of manholes, $3.30; for flush tanks, $80; 5 cu. yds. concrete masy., $10, and 25 sq. yds. cement plaster, 30 cts.

Chicago, Ill.—Bids are wanted June 20 for furnishing material and constructing complete, on foundation furnished by city, at the sewage pumping station at Lawrence and Evanston Aves., 4 centrifugal and screw pumping engines, as advertised in The Engineering Record.

A petition from Oak Park and Berwyn for additional sewer facilities has been presented to the Engr. Com. of the Drainage Bd. in a communication from Ch. Engr. Randolph, who estimated the cost of the improvement at about $58,600. This would provide for the extension of the extra avenue sewer from Ogden ditch 'to the main channel.

Local press reports state that bids will soon be asked by the Dept. of Pub. Wks. for the construction of Section T of the intercepting sewer.

Cairo, Ill.—Engr. W. B. Thistlewood, of Cairo, with Geo. F. Dewey have made a preliminary survey for a main outlet brick sewer for Cairo, to cost $100,000.

Richmond, Ind.—See "Paving and Roadmaking."

Michigan City, Ind.—The Bd. of Pub. Wks. is stated to have approved plans of the City Engr. for 10-in. sewers in Manhattan and Oak Sts.

Tell City, Ind.—It is reported that bids will be received until June 1 by the City Clk. for constructing the Humboldt St. sewer.

Franklin, Ind.—Otis B. Sellers, City Engr., writes that a resolution has been adopted providing for the construction of a sanitary sewerage system, to cost $20,000, but final action will be taken on June 6.

Tulsa, Ind. Ter.—N. J. Gubser, City Recorder, writes that bids will be received about June 1 for the construction of a sewerage system, to cost about $30,000. J. G. Patton, City Engr.

Clinton, Ia.—M. E. Jordan, City Clk.. writes that the citizens voted May 1' to construct a sewerage system, at a cost of $125,000. Chas. P. Chase, City Engr.

Des Moines, Ia.—City Engr. J. W. Budd is reported to be preparing plans for a sewerage system for South Des Moines.

Local press reports state that bids will be received until May 30 (readvertisement) by the Bd. Pub. Wks., for contsructing the Ingersoll Run Sewer. John W. Budd, City Engr.

Sioux City, Ia.—J. M. Lewis, City Engr., writes that the proposed sewer for Morning Side will be of tile, and cost about $20,000.

Lexington, Ky.—Rudolph Hering, of New York, N. Y., has been selected to supervise plans and specifications for the proposed sewerage system for Lexington. Thos. A. Combs, Mayor.

Greenville, Mich.—Riggs & Sherman, of Toledo, are stated to have been selected to prepare plans for a sewerage system to cost about $50,000.

Meridian, Miss.—J. H. Rivers, Mayor, writes that bids will probably be received about June 5 for the construction of a sewerage system; probable cost $35,000. Engineer, Waldo G. Myer.

St. Joseph, Mo.—City Engr. Floyd is reported to be preparing plans for an entirely new sewerage system for South St. Joseph, the contractors who recently secured the contract for this work having decided not to take it.

Maryville, Mo.—It is stated that bids are wanted June 6 by the City Clk. for constructing about 32,838 lin. ft. of vitrified pipe sewers, 3 flush tanks, 9 manholes, etc. Geo. Custer, City Engr.

Trenton, N. J.—Bids will be received until June 6 by the Common Council for constructing a sewer in a portion of Clinton Ave.; Harry B. Salter, City Clerk.

Little Falls, N. Y.—Bids will be received until June 2 by the Bd. Pub. Wks. for constructing a sewer in a portion of Danube St.; Jas. G. Hazlett, City Clk.

Lestershire, N. Y.—The following are the bids opened May 12 by the Village Trus. for constructing about 3 miles of pipe sewers (Engrs., Knight & Hopkins, of Rome): Timothy Reynolds, Fulton, $40,000; D. M. Rosser, Kingston, Pa., $36,457; J. H. Clements, Jr., Schenectady, $36,430; Frank Pidgeon, Saugerties, $36,375; M. A. Donahoe, Scranton, Pa., $32,875; Saml. Bane, Syracuse, $32,497, and J. D. Allen & Co., Oneida, $31,390.

Batavia, N. Y.—Alex. Potter, of N. Y. City, is reported to have been selected to prepare plans for a sewerage system for Batavia.

Harvey, N. D.—See "Water."

Bismarck, N. D.—Bids will be received June 1 by R. H. Thistlethwaite, City Aud., for furnishing materials and constructing a trunk sewer in a portion of Main St.; also lateral sewers in portions of several streets. Engineer's estimate: 96 lin. ft. 18-in. c. i. culvert pipe (outfall);

Mt. Carmel, Pa.—The following are the bids opened May 18 by the Boro. Council for constructing a sewerage system (Engineer, T. Chalkley Hatton, Wilmington, Del.): (*a*) Nolan Constr. Co., 520 Walnut St., Reading; (*b*) Irwin & Koester, Greenville, O.; (*c*) Hawman Bros., Reading; (*d*) R. A. Malone & Co., Lancaster; (*e*) D. M. Rosser, Kingston, Pa.; (*f*) De Nallo & Klingberg, Kingston, N. J.; (*g*) Gossart & Pascoe Co., Allentown; (*h*) Lloyd Collis, New York, N. Y.; (*i*) Caldwell, Barry & Co., Broad and Arch Sts., Philadelphia.

Pipe Sewers.	*a*	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*
27,000 ft. 8 in. average cut 7 ft. 6 in. standard	$1.24	$0.55	$0.84	$0.50	$0.50	$0.50	$0.61	$0.53	$0.40
3,200 ft. 10 in. average cut 8 ft. standard	1.33	.95	1.00	.60	.71	.90	.91	2.10	.52
8,500 ft. 12 in. average cut 8 ft. 1 in. standard	1.46	.90	1.10	.70	1.07	1.00	1.22	.95	.70
5,100 ft. 15 in. average cut 8 ft. 3 in. standard	1.71	1.20	1.32	.86	1.39	1.23	1.44	.95	1.10
2,800 ft. 18 in. average cut 8 ft. 6 in. double strength	2.09	1.35	1.80	1.02	1.65	1.60	1.70	1.20	1.45
800 ft. 20 in. average cut 9 ft. double strength	2.29	1.50	2.10	1.22	1.97	1.80	1.90	1.50	1.60
3,200 ft. 24 in. average cut 8 ft. 7 in. double strength	2.69	2.00	2.75	1.55	2.45	2.00	2.30	2.00	1.80
Brick Sewers.									
900 ft. 30 in. average cut 7 ft. 10 in. single ring	2.79	2.00	2.52	1.60	3.90	3.00	3.30	2.25	2.00
200 ft. 33 in. average cut 10 ft. 5 in single ring	3.49	2.50	3.02	2.00	4.70	3.25	3.45	2.75	2.25
200 ft. 36 in. average cut 10 ft. 2 in. single ring	3.69	2.80	3.17	2.30	4.70	3.60	3.60	3.10	2.60
600 ft. 42 in. average cut 11 ft. 8 in. double ring	4.24	5.10	5.98	4.10	6.50	5.25	5.50	6.10	5.00
Y Branches.									
1,100 8 in.	4.04	.50	.60	.40	.45	.40	.50	.41	.44
130 10 in.	4.46	.70	.80	.60	.68	.55	.66	.60	.65
440 12 in.	5.00	1.00	1.05	.75	.90	.80	.90	.68	.80
200 15 in.	5.99	1.40	1.40	1.00	1.25	.95	1.15	1.05	1.00
112 18 in.	7.71	2.00	1.80	1.30	1.50	1.65	1.90	1.85	1.60
30 20 in.	8.79	2.50	2.40	1.70	2.25	2.15	2.50	2.50	2.40
125 24 in.	10.93	3.50	3.40	2.40	3.00	3.00	3.50	3.50	3.00
70 5 in. slants	.24	.50	.30	.50	.30	.30	.30	.30	.25
38 lampholes, terra cotta stand pipe with c. i. cover	6.95	15.00	18.00	20.00	15.00	10.00	14.50	15.00	15.00
111 manholes, brick, 3 ft. 6 in diam.	64.00	45.00	55.00	30.00	40.00	42.50	46.50	57.50	45.00
10 interceptors, brick, 4 ft. diam., special	110.00	120.00	160.00	60.00	85.00	100.00	100.00	169.00	100.00
90 side and corner inlets, brick, with c. i. cover	120.00	70.00	87.00	50.00	63.00	60.00	65.00	88.00	80.00
90 grate inlets, brick, with c. i. grate	114.00	60.00	66.00	40.00	33.00	50.00	40.00	52.50	70.00
27 flush tanks, brick, Miller 5 in. siphons	155.00	90.00	98.50	40.00	100.00	75.00	75.00	75.00	65.00
5,000 cu. yds. rock excav	3.24	2.00	2.75	1.50	1.50	2.30	2.50	2.00	1.95
Total	$142,495	$81,987	$105,370	$62,258	$81,843	$84,614	$91,112	$86,856	$74,228

Items marked thus give the names of parties awarded contracts.

8,200 lin. ft. 18 in., 6,080 lin. ft. 12-in.; 4,180 lin. ft. 10-in. and 9,660 lin. ft.. 8-in. vitr. pipe; 138 y's 18x6-in.; 408 y's, 12x6-in., and 290 y's, 8x6-in.; 61 manholes; 8 manhole flush tanks (combination) and two 18-in. sluice gates; Saml. F. Crabbe, Engr., Fargo.

Norwood, O.—Engr. J. A. Stewart, Traction Bldg., Cincinnati, writes that bids will probably be called for in about 2 or 3 months for a sewerage system for Norwood, to cost about $25,000.

Mingo Junction, O.—C. S. Grimes, City Clk., writes that the cost of the proposed sewer for Church Hill is about $2,400. Engineer Robt. H. Williams, Mingo Junction.

Lorain, O.—See "Water."

Cleveland, O.—The lowest bid opened May 12 by the Bd. of Pub. Service for 15,000 lin. ft. 12-in. pipe sewer was submitted by the Hamlet Lumber & Supply Co., at 34 cts. per ft.; total, $5,100.

**Steubenville, O.*—S. B. Curfman, City Engr., writes that contracts for sewers (bids opened May 19) have been awarded as follows: To Jas. Ferry & Son, Crafton, Pa., for brick sewers, consisting of 5,090 ft. 36-in., 640 ft. 30-in., 150 ft. 24-in., 90 ft. 18-in. and 750 ft 12-in.; 27 manholes, and 42 catch basins, $19,971. To W. J. Townsend & Co., Cleveland, for brick and pipe sewers on Washington St., $12,122, and to J. A. George & Son, East Liverpool, for brick and pipe sewers on North St., $11,703.

Youngstown, O.—Bids will be received until June 1 by the Bd. Pub. Service (Geo. F. Prosser, Clk.) for constructing sewers in portions of Lexington and Chicago Aves. and Jefferson St.

The following are reported to be the bids opened May 9 by the Bd. of Pub. Service for the construction of Glenwood Ave. sewer: S. H. DeGroodt, $26,835; Chas. Smith, $41,798 Jas. Ferry & Son, $29,294; Rochfort & Cominskey, $30,871; Harrison & Heasley, $29,085; John Grady, $41,459, and Jas. McCarron, $32,686.

Cincinnati, O.—It is stated that bids will be received until June 1 by the Bd. Pub. Service for constructing sewers in Summit Ave., estimated to cost $2,502, and also until June 15 for constructing 4-ft. sewer in Lelland Ave., estimated to cost $6,178.

Lakewood, O.—It is stated that bids will be received until June 5 by Henry J. Sensel, Village Clk., for laying sewer mains in Matthews, Elanola and Sloane Aves.

Cambridge, O.—Bids are wanted June 12 for constructing extensions to the sanitary and storm systems of sewerage, as advertised in The Engineering Record.

Xenia, O.—Bids will be received by the Bd. of Pub. Service, June 10, for about 4 miles of sanitary sewers, as advertised in The Engineering Record.

Columbus, O.—The following are the bids opened on May 18 by the Bd. of Pub. Service (Julian Griggs, Ch. Engr.), for repairing Indianola sewer and constructing earth embankments: (bidders of Columbus unless otherwise mentioned) Reid & Snouffer, Sta. B. R. F. D., $10,187; A. F. Helm, 580 E. Madison Ave., Cleveland, $12,452; A. G. Pugh, Union Natl Bank Bldg., $12,474, and C. T. McCracken, 214 Schultz Bldg., $14,799. The detail bid of Reid & Snouffer, the lowest bidders, is as follows: 11,000 cu. yds. earth embankment, 42 cts.; 162 M. brick, furnished, $9 per M.; 405 M. brick laid, including cleaning old brick, $10 per M., and 1,700 lin. ft. wire fence reconstructed, 3½ cts. per lin. ft.

**Toledo, O.*—The following are reported to be the bids opened on May 16 by the Bd. of Pub. Service for constructing the Jackson St. sewer: Thos. McKinney & Sons, "The Nasby," $60,644 (awarded contract); Henry P. Streichler, $80,978 ;Breyman, O'Neill & Tansey, $77,821, and O'Sullivan & Sheehan, $63,791.

Cuyahoga Falls, O.—The City Council is reported to be considering the preparation of new plans for a sanitary sewerage system.

Akron, O.—The City Council is reported to have approved plans for the construction of a $40,000 sewer to prevent the contamination of Summit Lake by sewage.

Erie, Pa.—Bids are wanted June 1 for the construction of 24, 18, 15, 12, 9 and 6-in. sewers, as advertised in The Engineering Record.

Gettysburg, Pa.—J. F. Wisotzkey, Secy. of Council, writes that the citizens voted May 23 to issue $30,000 bonds, for the construction of a sewerage system. No engineer selected as yet.

Susquehanna, Pa.—It is stated that bids will be received until June 7 by the Boro. Council (D. J. Lynch, Secy.) for constructing sewers in various streets.

Milton, Pa.—It is stated that bids will be received until June 13 by the Town Council for contsructing a sanitary sewer in Shakespeare Ave. and Mahoning St., requiring about 1,150 ft. 10-in. and 425 ft. 8-in. terra cotta pipe with the necessary manholes, house connections, etc.

Sharon Hill, Pa.—The following are reported to be the bids opened by the Boro Council May 16 for the construction of a sewerage system: West, Newcomb & Co., Philadelphia, $24,134; M. Jos. McHale & Co., Philadelphia, $21,368; John Dick, Darby, $17,495; Robt. P. Ryan, Philadelphia, $27,563; Edwin H. Vare, Philadelphia, $17,856; Grossart Pascoe & Co., Philadelphia, $23,057; David Peoples, Philadelphia, $23,500.

Nashville,, Tenn.—The Mayor has approved the ordinance appropriating $6,000 for extending the Edgefield sewer, and $3,700 for extending the Hume St. sewer.

San Antonio, Tex.—City Engr. J. D. Rullman is reported to be completing plans and specifications for the Laurel Heights sewerage system.

Ft. Worth, Tex.—The special committee appointed by Council to consider the construction of new sewers has reported, recommending that a sewerage system be constructed in portions of the 5th, 6th, 7th and 8th Wards not now reached under the present system, and that J. B. Hawley, City Engr., be requested to prepare plans and estimates for same.

**Puyallup, Wash.*—The following are the bids opened May 10 by City Council for constructing a sewerage system complete in Dist. A. (Engineers, Dunn, Coale & Dunn, Alaska Bldg., Seattle): E. M. Moore, Tacoma, $25,200; F. A. Keasal, Tacoma, $24,773; E. W. Riner, Portland, Ore., $31,200; James Lee, Tacoma, $24,035 (awarded contract); Geo. Milton Savage Co., Tacoma, $25,400; North West Bridge Co., $26,806, and Lister & Scott, Tacoma, $25,441.

**Bellingham, Wash.*—The contract for the building of the Elk St. trunk line sewer and septic tank is stated to have been awarded to K. Sauset for $6,921.

**Milwaukee, Wis.*—C. J. Crilley, 2018 Cedar St., is stated to have secured the contract for continuing the 8-ft. intercepting sewer in 30th St. for $25,000; also for a brick sewer in 22d Ave. for $23,000 (bids opened May 20).

Stevens Point, Wis.—Bids will be received June 5 by H. J. Finch, City Clk., for constructing sewers in portions of 5 streets.

Stratchcoma, Alta, Canada.—See "Water."

Fernie, B. C.—See "Water."

Regina, N. W. Ter.—See "Power Plants, Gas and Electricity."

BRIDGES.

Notes Arranged Alphabetically by States.

Redding, Cal.—It is stated that bids will be received until July 6 by the Bd. Superv. for constructing a bridge across Eagle Creek at Ono.

Kingston, Ga.—It is stated that bids will be received by the Co. Comrs. (L. P. Gaines, Chmn., Cave, Ga.) until June 15 for constructing a bridge across Etowah River, near Kingston.

Ft. Wayne, Ind.—It is stated that bids are wanted until May 31 for superstructures of concrete and iron steel bridges and concrete arches; J. L. Smith, Co. Aud.

Bloomfield, Ind.—It is reported that bids will be received until June 5 by the Rd. Co. Comrs., for constructing a 60-ft. steel beam bridge over Baughman Pond, in Washington Township; W. H. Deckard, Co. Aud.

Plymouth, Ind.—It is reported that bids will be received until June 6 by the Bd. Co. Comrs. for constructing 3 iron bridges and 1 concrete arch; H. L. Singrey, Co. Aud.

Stockdale, Ind.—It is stated that John Ross, of Frankfort, will construct a bridge 275 ft. long over Eel River at Stockdale, to cost $12,000.

Garnett, Kan.—It is stated that bids are wanted until June 5 by the Bd. Co. Comrs., for erecting a number of steel bridges in this county; M. J. Keeton, Co. Clk.

Atchison, Kan.—Fred. Giddings, City Engr., is preparing plans for a culvert of about 36 ft. span, length 415 ft. the bench walls to be of concrete on pile foundation, arch of vitrified brick or reinforced concrete.

Iola, Kan.—It is stated that bids will be received until June 7 by the Co. Comrs. for constructing 4 steel bridges.

Townson, Md.—See "Paving and Roadmaking."

**Lenox, Mass.*—Henry L. Norton, Consulting Engr., Springfield, writes that the New Jersey Bridge Co., of New York, N. Y., has secured the contract for constructing a bridge at Lenoxdale, bids opened May 30 by the Bd. of Selectmen, for $3,237.

Pontiac, Mich.—Bids will be received until June 5 by the City Council for constructing 7 concrete steel bridges over Clinton River on W. Lawrence, Bagley and Union and Paddock Sts., as advertised in The Engineering Record.

Jersey City, N. J.—Bids will be received by the Bd. Chosen Freeholders (John P. Noonan, Deputy Clk.) until June 1 for constructing the new centre pier of the Newark Ave. bridge over the Hackensack River.

Mt. Holly, N. J.—Bids will be received until June 1 by the Com. Bd. Chosen Freeholders (C. Craig Tallman, Chmn.) for bids including plans for a bridge to be constructed over Assiscunk Creek, Springfield Township; also bids including plans will be received by the Com. Bd. Chosen Freeholders (Wm. A. Wilkins, Chmn.) for a bridge to be constructed over Darnell's Mill stream, Mt. Laurel Township, and repairing abutments to said bridge.

Lockland, O.—The following bids are stated to have been received by the Bd. Co. Comrs. at Cincinnati on May 5 for constructing a wrought iron and steel superstructure of a lift bridge over the Miami and Erie Canal at Lockland: Indiana Bridge Co., $24,000; Virginia Bridge Co., $22,500; Huston & Cleveland, $21,100; King Bridge Co., material, $11,000; labor, $5,000; material and labor, $11,900; Cope Bridge Co., $27,000; Illinois Bridge Co., $31,000; Geo. R. Barry, $16,000; Brackett Bridge Co., plan 1, $21,250; plan 2, $20,800; plan 4, $14,900; Newcastle Bridge Co. $25,900; Champion Bridge Co., $13,100; Toledo & Massillon Bridge Co., $21,000. Each company bid upon its own plans under specifications provided by County Engr. Krug.

Mansfield, O.—It is stated that bids will received by the Bd. Pub. Service until June 1 for constructing stone and concrete masonry abutments to bridge, culverts, etc.

Cleveland, O.—Bids will be received by the Bd. Co. Comrs. (Julius C. Dorn, Clk.) until June 10 for constructing a steel bridge, concrete steel culvert and abutments to 3 bridges in Royalton Township; also a concrete steel culvert in Brecksville Township; Wm. H. Evers, Co. Engr.

The lowest bid opened on May 16 by the Bd. of Pub. Service for constructing a steel arch in Edgewater Park, was submitted by the Block Bridge & Culvert Co., for $5,192.

Tillamook, Ore.—It is stated that bids will be received by the Co. Comrs. until July 5 for constructing a bridge across Big Nestucca River. G. B. Lamb, Co. Clk.

Knoxville, Tenn.—It is stated that bids will be received until June 1 by the Louisville & Nashville Ry. Co. (W. H. Courtenay, Ch. Engr., Louisville, Ky.) for constructing a viaduct across Clinch Ave. of steel concrete construction with approaches, to cost about $80,000.

**Weatherford, Tex.*—The Comrs. Court is reported to have awarded the contract for constructing 2 bridges over Brazos River one at Bannon Crossing the other at McDonald Crossing to Mitchell & Pigg, for $28,000.

Dallas, Tex.—It is reported that bids will be received by the Co. Comrs., June 1, for the construction of several steel bridges. B. F. Uhl, Co. Engr.

Mitchell, Ont.—It is stated that bids will be received until June 6 by Wm. Davidson, Co. Clk., for constructing a steel bridge across Thames River and constructing abutments, wing walls and approaches. John Roger, Engr., Mitchell.

Crysler, Ont.—It is stated that bids will be received until June 1 by J. A. Cockburn, Township Clk., for constructing concrete piers and building approaches for bridge to cross Payne Rive.r W. H. Maywood, Engr., Cornwall, Ont.

Miniota, Man.—It is stated that bids will be received until June 13 for constructing a bridge across the Assiniboine. Address W. Howard, Miniota.

Moncton, N. B.—It is stated that bids will be received until May 31 by D. Pottinger, Gen. Mgr. Intercolonial Ry. Co., for constructing substructure of a double-track bridge to be erected near Bedford Station, N. S., and for substructure of 2 single-track bridges, one near Mitchell Station, Que., and the other near St. Leonard Junction Station, Que. W. B. McKenzie, Ch. Engr., Moncton.

PAVING AND ROADMAKING.

Notes Arranged Alphabetically by States.

**Pine Bluff, Ark.*—I. P. Shelby, of Pine Bluff, is stated to have received the contract for paving with vitrified brick a portion of Barraque St., at $1.96 per sq. yd. or $40,000 for the improvement. Bids opened May 10 by the Comrs. of Paving Dist. No. 18.

Grand Junction, Colo.—Bids will be received by Chas. E. Burton, Supt., Indian School, Grand Junction, for furnishing materials and laying about 11,400 sq. ft. of cement sidewalk.

**Denver, Colo.*—The Denver & Pueblo Pavng Co. is stated to have received the contract (bids opened May 19) for paving in West Denver Improvement District No. 1 for $143,000.

Somers, Conn.—Bids will be received until May 31 by the Bd. Selectmen (Geo. B. Pease, Chmn.) for constructing a section of gravel road.

Wilmington, Del.—The Street and Sewer Dept. is arranging to pave a number of streets with asphalt. This will be the first asphalt paving in Wilmington.

Washington, D. C.—See "Power Plants, Gas and Electricity."

Tampa, Fla.—Press reports state that bids will be received until June 7 by the Bd. Pub. Wks., for $440,000 bonds, a portion of the bonds to be used for street improvements.

**Chicago, Ill.*—The Bd. of Local Improv. is stated to have awarded on May 12 contracts as follows: R. T. Conway, 138 Washington St., Bickerdyke St., $13,537 and 33d St., at $43,168; Citizens' Constr. Co., for Erie St., $19,322, Halstead St., $42,783, Orleans St., $16,982; Union Paving Co., for Prairie Ave., $17,851 and Winchester Ave., $36,302; Barber Asphalt Paving Co., Stock Exchange Bldg., W. 22d St., $37,750.

**Canton, Ill.*—M. Heckard & Sons are stated to have received the contract for paving with brick about 2,548 ft. of W. Walnut St., at $1.23 per sq. yd., excavating, 30 cts. per cu. yd.; 48 cts per lin ft for new curb

Freeport, Ill.—Bids are wanted June 3 for paving Liberty St., with brick, as advertised in The Engineering Record.

**Terre Haute, Ind.*—The following bids are stated to have been received May 17 for paving with brick 15,500 sq. yds. on Wabash Ave.: Foulkes, Forbes & Co., of Terre Haute, $27,688 (awarded contract); Roberts & Co., $27,749; W. H. Harris, $27,785; Michael H. Stevens, $27,902; Jesse Robertson, $28,500, and Keegan Bros., $29,800.

Bloomfield, Ind.—It is reported that bids will be received until June 5 by the Bd. Co. Comrs., for constructing gravel and macadamized roads in Grant Township; W. H. Deckard, Co. Aud.

Rockville, Ind.—It is reported that bids will be received until June 5 by the Bd. Co. Comrs. for constructing a gravel road in Penn Township; Henry Grubb, Co. Aud.

Shelbyville, Ind.—It is reported that bids will be received until May 30 by the City Council, for constructing cement sidewalks on portions of 5 streets; E. C. Newton, City Clk.

Normal City, Ind.—The following bids are reported to have been opened on May 16 by the City Bd. of Trus. for constructing cement sidewalks and gravel roadways on *a* Dix St. and *b* Talley Av. (price given per lin. ft.): *a* Wm. Birch, $1.37; *a* Harry Moore, $1.765; *a* Boone County Constr. Co., of Lebanon, $1.865 and *b* $2.70.

Richmond, Ind.—The Bd. of Pub. Wks. is stated to have authorized the city engr. to prepare plans for macadamizing N. 3d and South E. St. and for a storm sewer on N. 11th St.

**Pittsburg, Pa.*—The following are the bids opened on May 17 for constructing a stone arch bridge on Lincoln Ave.: (*a*) C. M. Driver, Penn Bldg.; (*b*) Stratton, Lewis & Co., 327 First Ave.; (*c*) F. Felkel Son & Co., House Bldg.; (*d*) Friday & Co., Fitzsimmons Bldg. (awarded contract); (*e*) Dravo Constr. Co., Lewis Block; (*f*) Fogel & Francy, Marshall Ave.; (*g*) Columbia Contr. Co., Frick Bldg. The city furnishes and calks all the water pipe; price given below only for the laying.

	a	*b*	*c*	**d*	*e*	*f*	*g*
Work complete as shown on plans	$137,337	$199,620	$199,560	$129,158	$129,300	$139,000	$150,813
Additional concrete in place 1:2½:5	6.00	7.87	6.50	5.50	5.40	6.40	6.00
Additional stone with concrete backing	7.75	8.04	8.75	11.00	9.00	7.90	8.20
6,100 cu. yd. additional earth fill.	.37	.65	.50	.90	.30	.50	1.00
503 sq. yd. blockstone paving gravel found.	2.25	2.81	2.25	2.00	2.10	2.50	1.75
277 sq. yd. resetting block stone paving	.75	78	.75	.70	.50	.50	.75
18.732 M. ft. B. M. white pine sidewalk	.04	.04	.036	.045	.05	.05	.04
470 lin. ft. laying 20 in. c. i. water pipe	.15	.15	1.00	.60	1.00	.50	2.65
173 lin. ft. laying 6 in. c. i. water pipe	.15	.05	1.25	.20	.50	.30	.85
990 lin. ft. sandstone curb....................	.77	.70	.85	.75	.75	.60	1.00
417 lin. ft. sandstone curb reset	.37	.30	.35	.25	.35	.25	.65
555 lin. ft. 20 in. c. i. sewer pipe laid in concrete	3.87	8.20	5.50	7.00	12.00	1.50	8.70
206 lin. ft. 3 ring brick sewer	15.00	14.12	12.50	16.00	28.00	11.25	12.50

**Items marked thus give the names of parties awarded contracts.*

Brownstown, Ind.—It is stated that bids will be received by the Co. Comrs. until June 5 for constructing 2 roads, the total length to be about 63,418 ft. Ellis S. Rees, Co. Aud.

Logansport, Ind.—The Bd. of Pub. Wks. has passed a resolution providing for the paving of North St., from 3d to 12th St., with Warren's bitulithic pavement. Walter A. Osmer, City Engr.

Clinton, Ia.—Chas. P. Chase, City Engr., writes that it is proposed to expend about $40,000 on paving, material undecided, probably brick or asphalt.

Hutchinson, Kan.—A correspondent writes in regard to paving, bids for which are to be opened here June 1, that there will be required 30,114 sq. yds. brick paving, the base to be of 1-3-6 concrete and filler of Pioneer asphalt; 7,259 ft. cement curb and 13,324 cu. yds. earth excav. T. G. Elbury, City Engr.

Kansas City, Kan.—It is stated that bids will be received until June 5 by Frank H. Holcomb, Co. Clk., for constructing a macadam pavement on Parallel Road, a distance of about 1 mile.

Emporia, Kan.—The paving, bids for which will be opened on June 5, consists of paving of 13 blocks with brick. The specifications, which can be secured by writing Geo. Mathewson, City Clk., call for brick, two courses, brick one course on broken stone concrete and brick, one course on gravel concrete. J. H. Glotfelter, Chmn. Paving Com.

Louisville, Ky.—The Barber Asphalt Paving Co., 345 5th St., is stated to have submitted the lowest bid on May 17 for paving with asphalt 4,100 ft. on Frankfort Ave.; their bid was $1.81 per sq. yd.

Danville, Ky.—It is stated that bids will be received until June 1 by Reed S. Nichols, Chmn. Com. of Boyle County Fiscal Court for constructing a turnpike from Junction City to Pine Knob turnpike, near Alum Springs.

Baton Rouge, La.—See "Water."

Rockville, Md.—Bids will be received until June 2 by the Bd. Co. Comrs. (Robt. G. Hilton, Clk.) for grading and macadamizing about 1 mile of road on the public highway between Gaithersburg and Laytonsville.

Baltimore, Md.—Bids will be received by the Bd. of Awards (E. Clay Timanus, Pres.), until May 31 for grading a portion of St. Paul St. and Merryman's Lane Boule.; the total estimated work is 60,970 cu. yds. excav. and 56,520 cu. yds. fill; B. T. Fendall, City Engr.

Cumberland, Md.—Bids will be received June 1 by the Bd. Co. Road Dirs., for grading and macadamizing about 1 mile of Bedford Road.

Towson, Md.—Bids will be received June 8 by the Highway Comrs., for grading and macadamizing about 2 miles of Wilkens Ave., and constructing a 26-ft. span concrete-steel bridge. H. G. Shirley, Roads Engr.

Ellicott City, Md.—Bids will be received until May 30 by the Bd. Co. Comrs. (Frank Parlett, Clk.) for grading and macadamizing about 3,000 ft. road, bet. W. Friendship and Sykesville.

Ft. Strong, Mass.—Bids will be received until June 14 by Maj. John E. Baxter, Constr. Q. M., U. S. A., 170 Sumner St., Boston, for constructing a section of macadam road, brick, gutter and granolithic pavement at Ft. Strong, Long Island, Mass.

**Holyoke, Mass.*—Contracts for paving, etc. (bids opened May 5 by the Bd. of Pub. Wks.) are stated to have been awarded as follows: To Barber Asphalt Paving Co., New York, N. Y., for furnishing material and laying about 12,000 sq. yds. asphalt paving at $1.80 per sq. yd. with 10 yr. guarantee; to the California Asphaltum Sales Agency of New York, N. Y., for all sidewalk material required at $23.50 per ton "L" grade asphaltum, and $21.50 "D" grade asphaltum, and to Daniel O'Connell & Sons, of Holyoke, for 3,000 sq. yds. wood block paving at $31.50 per M. block, f.o.b. Holyoke.

West Boylston, Mass.—L. E. Jaynes, of Boston, Clk. Metropolitan Water and Sewerage Bd., writes that the contract for building about 2¾ miles of macadam road, chiefly in W. Boylston (bids opened May 19), has been awarded to the H. Gore Co., 54 Kilby St., Boston, for $16,573.

Ann Arbor, Mich.—Bids will be received by Ross Granger, City Clk., June 3, for about 8,000 sq. yds. brick or asphalt paving on N. University Ave. and Ashley St., as advertised in The Engineering Record.

Muskegon, Mich.—Bids are wanted June 3 for 3,500 cu. yds. crushed stone, as advertised in The Engineering Record.

Houghton, Mich.—It is stated that bids will be received until June 12 by Casper Brand, Village Clk., for grading, curbing and paving on College Ave.

Detroit, Mich.—The Council is reported to have decided to reject all bids recently received for the construction of a municipal brick plant, and authorized Wm. H. Maybury, Comr. of Pub. Wks., to employ an expert to prepare plans and specifications for such a plant.

St. Paul, Minn.—City Engr. Rundlett is stated to have estimated the cost of improving portions of streets as follows: Paving Maria Ave. sand-lime brick, $25,865; asphalt, $25,539; vitrified brick, $22,819; creosoted blocks, $28,259; sandstone, $30,979; granite, $33,699. Macadamizing E. 7th St., estimated cost, $24,750.

Bids will be received June 5 by the Bd. Co. Comrs. for constructing a stone and gravel road on a portion of Rice St.; Edw. G. Krahmer, Co. Aud.

Duluth, Minn.—Petition for paving Mesaba Ave., Piedmont Ave., W., and Superior St., from 8th Ave., W., to 25th Ave., W., have been filed with the Bd. of Pub. Wks. Engineer's estimate: Creosote blocks on concrete, $182,998; standstone blocks on sand, $135,956; tar macadam, $111,659, and Telford macadam, $80,384.

*The following are the bids opened by the Bd. of Pub. Wks. for paving 1st St., from 6th Ave., W., to 1st Ave., E., about 15,985 sq. yds. paving, 1,400 sq. yds. brick gutter, 5,400 lin. ft. curb set in concrete, etc., (*a*) asphalt, (*b*) creosote block, (*c*) sandstone block, (*d*) tar macadam: P. McDonnell, 124 W. Superior St., *a* $40,315; *b* $42,656 (awarded contract); *c* $38,396; *d* $29,319; Geo. R. King, *b* $46,743; *c* $41,828; *d* $35,554; Lang & Preston, *b* $46,814; *c* $43,458; Warren Bros. Co., *a* $38,255; Barber Asphalt Co., *a* $36,593; Fred. A. Malette, *d* $32,427.

**St Joseph, Mo.*—The Bd. of Pub. Wks. is stated to have awarded contracts as follows for paving with brick portions of 16th, Robidoux and 2d Sts. to Phoenix Brick & Constr. Co. for $28,875; also for a portion of 21st St. with brick to Rockcliffe & Gibson, 619 Edmond St., for $7,733.

St. Louis, Mo.—The following are reported to be the lowest bids opened by the Bd. Pub. Improv. on May 9 for paving portions of streets: Theodosia Ave. with asphalt, Barber Asphalt Paving Co., $8,044; Haven St. and Ware Ave. with brick, Fruin & Colnon, for $12,159 and $20,119 respectively; Clara Ave. with brick, Henkel & Sullivan, $14,314; Nebraska, Spring, Warne, Ferdinand and Hamilton Aves. with brick, Skrainka Constr. Co., $47,296; Tiffany St. with brick, Geisel Constr. Co., $2,160; McRee Ave. with brick, G. Eyermann, $7,951; Clemens and Ashland Ave. and Grant St. with bituminous macadam, Granite Bituminous Paving Co., $13,794.

**Ft. Omaha, Neb.*—The contract for constructing roads, walks and gutters at Ft. Omaha is stated to have been awarded to E. D. Van Court, of Omaha, for about $14,000.

Jersey City, N. J.—Bids will be received June 1 by the Co. Bd. Boule. Comrs. (Walter OMara, Clk.) for resetting curb and repaving gutters on Hudson Boule.

*Geo. T. Bouton, Clk. St. and Water Bd., writes that the contract for improving a portion of Bergen Ave. (bids opened May 22) has been awarded to Uvalde Asphalt Paving Co., 2 Greene St., at 84 per cent. of the standard price; also same date to Henry Byrne for repaving Grove St. at 82½ per cent.

Morristown, N. J.—Bids will be received by the Bd. of Chosen Freeholders at Morristown on June 19 for macadamizing certain sections of county roads, as advertised in The Engineering Reecord.

Freehold, N. J.—Bids will be received until June 14 by the Bd. Chosen Freeholders at Freehold (John Guire, Dir.) for furnishing material and building the first section of the Allentown and New Egypt Stone road, in all about 3½ miles, and the first section of the Freehold and Colts Neck macadam road, about 3 miles long. Peter Forman, Engr., Manalapan, N. J.

New York, N. Y.—The following are the bids opened May 16 by Louis F. Haffen, Pres. Bronx Boro, for regulating, etc., 259th St., from Bway to Riverdale Ave.: D. W. Moran, $44,604; Troy Public Wks. Co., $40,440; Bellew, Merrit Co., $48,244; C. W. Collins, $41,035; G. I. Bailey, $38,956. The detail bid of the lowest bidder, G. I. Bailey, is as follows: 3,000 cu. yds. earth excav., 62 cts.; 8,700 cu. yds. rock excav., $1.62; 28,000 cu. yds. fill, 41 cts.; 4,125 lin. ft. new curb, 80 cts.; 15,500 sq. ft. new flag, 25 cts.; 3,600 sq. ft. new bridgestone, 60 cts.; 1,200 cu. yds. dry rubble masonry, $1.75; 50 lin. ft. 12-in. vitr. pipe, 75 cts., and 50 lin. ft. 18-in. vitr. pipe, $1.

New York, N. Y.—The following are the bids opened May 10 by John F. Ahearn, Pres. Manhattan Boro. for (*a*) 56,670 sq. ft. new flag, (*b*) 26,530 sq. ft. old flag. to retrim and relay, (*c*) total: D. W. Moran, *a* 26 cts., *b* 2 cts., *c* $15,265; Bar & Drum, *a* 27½ cts., *b* 1½ cts., *c* $15,982; P. J. Kane, *a* 27 cts., *b* 5 cts., *c* $16,627; Cunningham & Kearns, *a* 26 cts., *b* 2 cts., *e* $15,265; W. J. Fitzgerald, *a* 26½ cts., *b* 3 cts., *c* $15,813; D. McCarthy, *a* 25 cts., *b* 4 cts., *c* $15,229; Thos. A. Brown, *a* 25 cts., *b* 2½ cts., *c* $14,831.

Bids were opened same time and place for regulating and repaving with asphalt on present pavement laid as foundation, 67th St. from Ave. A to 3d Ave.; Asphalt Constr. Co., 137th St., and Madison Ave., $9,518; Barber Asphalt Paving Co., $10,884; Century Constr. Co., $11,957; Uvalde Asphalt Paving Co., $10,632; Sicilian Asphalt Paving Co., $10,683. The detail bid of the lowest bidder, the Asphalt Constr. Co., is as follows: 6,550 sq. yds. asphalt, including binder course, 75 cts.; 6,600 sq. yds. old stone pavt. relaid as foundation, 25 cts.; 3,100 lin. ft. new curb, 80 cts.; 550 lin. ft. old curb. reset, 32 cts., and 20 noiseless covers, ea. $15.

The following are the bids opened May 11 by the Comrs. of Parks for paving with rock asphalt the present cobblestones and stone block gutters of carriage drives in Central Park, to consist of 1,450 cu. yds. concrete, 70,000 sq. ft. rock asphalt, 2 in thick, 5,000 ft. rock asphalt 1 in. thick; 4 cu. yds. bituminous binder and 60 sq. yds. rock asphalt 2 in. thick: Sicilian Asphalt Paving Co., 41 Park Row, $27,892, and Vulcanite Paving Co., 114 Liberty St., $29,287.

Bids will be received until June 1 by the Park Bd. (John J. Pallas, Pres.) for furnishing and setting and resetting curbstones, paving with asphalt blocks, and otherwise improving a portion of Cathedral Parkway, Boro. Manhattan.

Brooklyn, N. Y.—Bids will be received until June 14 by Martin W. Littleton, Boro. Pres., for regulating, grading, curbing, paving and repaving portions of 13 streets. Engineer's estimate: 54,105 sq. yds. asphalt pavt.; 4,100 sq. yds. granite blk. pavt., with tar and gravel joints; 8,180 cu. yds. concrete; 72,940 sq. ft. cement sidewalks; 20,966 lin. ft. new curb, to be set in concrete; 22,710 lin. ft. new curb.; 6,340 lin. ft. old curb, to be reset; 36,848 cu. yds. earth excav.; 117 noiseless covers and heads, complete, for sewer manholes, etc.

Cortland, N. Y.—The Bd. of Pub. Wks. is stated to have opened the following bids on May 15 for paving a portion of Pendleton St.: Warner-Quinlan Co., of Syracuse, sheet asphalt with stone curb $6,173, with cement curb $5,160; Barber Asphalt Paving Co., of Utica, asphalt with stone curb $7,240, with cement curb $6,628; The Warren Bros. Co., of Boston, Mass., with bitulithic and stone curb $9,140, with cement curb $8,913, and T. J. Conroy, of Oneida, with brick and stone curb $7,450, with cement curb $6,705.

Corning, N. Y.—Bids will be received by the Bd. of Pub. Wks., June 15, for laying 1,700 lin. ft. brick pavement on E. Market St., as advertised in The Engineering Record.

Rensselaer, N. Y.—The following bids are stated to have been received May 16 for paving a portion of 3d St. and Boray; *a* excavating (price given per cu. yd); *b* furnishing and setting new curb (price given per lin. ft.; *c* paving with Mack brick; *d* paving with B. and S. block (price given per sq. yd.); *e* catch basins: Mulderry Bros., of Albany, Catherine St., *a* 28 cts., *b* 70 cts., *c* $2.49, *d* $2.35; M. F. Dollard, of Albany, for Catherine St., *a* 40 cts., *b* 79 cts., *e* $90 each, *c* $2.22; for Bway, *c* $1.675.

Gloversville, N. Y.—Bids are wanted until June 5 for constructing 9,100 sq. yds. block asphalt and bitulithic pavement; Morrell Vrooman, City Engr.

Plattsburgh, N. Y.—The Bd. of Pub. Wks. is stated to have opened the following bids on May 16 for paving Margaret and Bridge Sts.: M. J. Fitzpatrick (2 bids) $3 and $2.95 per sq. yd.; Hastings Pavement Co., of Hastings, $2.37 per sq. yd.; Alfred Farley $2.19 per sq. yd.

Ft. Caswell, N. C.—Bids will be received until June 1 by Lieut. R. H. Williams, Q. M., U. S. A., for constructing roads and walks here.

**Mound City, O.*—Henkel & Sullivan, of St. Louis, Mo., are stated to have received the contract for improving streets in Mound City for about $50,000.

Salem, O.—Bids will be received May 31 by the Township Trus. (Henry Brooks, Clk.) for furnishing materials and constructing about 2 miles pike on the Carey Road.

Columbus, O.—Bids will be received until June 1 by the Bd. Pub. Service (Chas. H. Frank, Secy.), for grading, curbing and paving on a portion of Hildreth Ave. and Almond Alley with asphalt, hard burned brick or block, macadam or other substantial material.

**Bucyrus, O.*—The following bids are stated to have been received May 1 by the Bd. Pub. Service for paving about 15,700 sq. yds. with brick on Sandusky Ave.; T. W. Hill, Toledo, $18,784; A. H. Gardner, Bucyrus, $18,190; C. F. Davis, Bucyrus, $16,280; E. A. Freshwater, Chester, W. Va., $15,791; Mat A. Mulligan, Ironton, $16,236 (awarded contract); W. S. Hadley, Canton, $16,900; Babst & Boermuth, Crestline, bids not totaled; Barber Asphalt Co., Cleveland (asphalt), two bids, $18,154 and $19,732; W. H. Raymond & Co., Galion, 3 bids, $9,396, $10,422 and $9,790; T. B. Townsend Brick Constr. Co., of Zanesville, $11,370; Shaw & Alder, Columbus, $19,180; Petter Straub, 10 bids ranging from $12,633 to $10,422.

Cincinnati, O.—Bids will be received until June 12 by the Bd. Pub. Service (Geo. F. Holmes, Clk.) for grading, curbing and paving a portion of Borden St. with brick; also for grading, curbing and paving with granite blocks a portion of Poplar St.

**Sandusky, O.*—B. J. McGory, Clk. Bd. Pub. Service, writes that the contract for paving 2 blocks of Railroad St. with Logan block (bids opened May 16) has been awarded to John McKean, of Sandusky, for $10,896. About 1-3 of the work will have bituminous filler.

Cleveland, O.—Bids will be received until June 10 by the Bd. Co. Comrs. (Julius C. Dorn, Clk.), for improving a portion of the State road in Parma and Royalton Townships; Wm. H. Evers, Co. Engr.

**Delaware, O.*—E. S. Mendenhall, Co. Engr., writes that contracts for road improvement (bids opened May 8, 9, and 10), have been awarded as follows: To N. C. Wooley, Marion, 4 miles, $8,250; J. M. Richey, Warrensburg, 3 1-3 miles, $6,000; Louis Marquett Hyattsville, 3 3-10 miles, $6,175; Wain Hazleton, Delaware, 1¾ miles, $3,065; Cary & Huston, Claiborne, 1 2-10 miles, $1,275; Stover, Mills & Myers, Ostrander, 1½ miles, $1,875; Brady & O'Connell, Marion, 1½ miles, $3,075, and A. B. Mayfield, Norton, 2 2-10 miles, $3,660.

Cincinnati, O.—Bids will be received until June 15 by the Bd. Pub. Service (Geo. F. Holmes, Clk.), for grading, curbing and paving with asphalt a portion of E. 5th St. also grading, curbing and paving with bitulithic on a portion of Prospect Pl.

Street Improvement Bonds amounting to $350,000 are reported sold.

South Newburg, O.—Bids will be received until June 25 by H. H. Bohning, Village Clk., for $25,000 highway improvement bonds.

Akron, O.—The City Council is stated to have decided to issue $24,200 bonds for improving Spicer and Arch Sts.; also for sewers on Jewett St. and Rhoades Ave.

**Waynesburg, Pa.*—Ott Bros., 414 Washington Ave., Pittsburg, are stated to have received contracts for constructing 2 roads in Greene County, the first to be macadam extending from Waynesburg through Franklin Township at a cost of $29,000. The second a brick road extending through West Waynesburg, at a cost of $14,000.

**Stroudsburg, Pa.*—The Frazier Constr. Co. is stated to have received the contract for constructing a road in Tobyhanna Township for $31,000; also for a road in Barrett Township for $6,400.

Wellsville, N. Y.—R. H. Lee, City Engr., writes that the following are the bids opened May 9 for paving with brick S. Main St.; (*a*) John J. Higgins, Waverly; (*b*) John Mahoney, Jamestown; (*c*) J. M. Homer, Olean; (*d*) Ruthven & Co., Buffalo; (*e*) Thos. Fitzgerald, Jr., Fredonia; (*f*) McGreevy Constr. Co., Ithaca; (*g*) Francis J. McCann, Elmira; (*h*) Costello & Nagle, Elmira; (*i*) John R. Baxter, Jr., Utica; (*j*) Chambers & Grady, Rochester; (*k*) Robt. W. Henson, Geneva.

	a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*j*	*k*
2,400 cu. yds. earth excav.	$0.30	$0.35	$0.30	$0.35	$0.45	$0.25	$0.50	$0.30	$0.25	$0.27	$0.35
4,246 lin. ft. curb (gravel foundation)	.60	.54	.46	.50	.55	.56	.65	.54	.55	.62	.59
1,000 lin. ft. curb (concrete foundation)	.59	.56	.80	.65	.59	.58	.70	.67	.55	.75	.59
80 lin. ft. circular curb	.75	1.00	.80	1.00	2.50	.92	.95	.75	.85	.92	.80
3,500 lin. ft. 4-in. drain tile	.08	.07	.04	.14	.15	.10	.12	.10	.05	.06	.10
286 lin. ft. heading stones	.05	.48	.20	.20	.25	.58	.27	.30	.50	.20	.25
10,944 sq. yds. pavt. (brick) on concrete foundation	1.67	1.62	1.74	1.69	1.63	1.65	1.82	1.70	1.65	1.68	1.59
Total	$23,147	$21,886	$22,864	$22,740	$22,646	$22,210	$25,157	$22,787	$21,933	$22,762	$21,828

**Items marked thus give the names of parties awarded contracts.*

**Pittsburg, Pa.*—The Dept. of Pub. Wks. is stated to have on May 20 awarded the contract for repaving with asphalt, Annabel, Bryant, Cordelia and Portland Sts. to the Barber Asphalt Paving Co., of Scranton, for $1.56 per sq. yd., or a total of about $16,000.

The following bids are stated to have been received May 22 by the Dept. Pub. Wks. for constructing and delivering a municipal asphalt pavement repair plant: Kelly Road Roller Co., of Springfield, O., $9,631, and Wadsworth Stone & Paving Co., of Pittsburg, for $6,750.

**Freeport, Pa.*—Engr. G. B. Findley, of Freeport, writes that the contract for sewering, grading, curbing and paving High, Buffalo, Franklin and 3d Sts. (bids opened May 15), has been awarded to E. A. Freshwater & Sons, of New Cumberland, W. Va.

West Homestead, Pa.—Jas. Lawry, Boro. Clk., writes that it was voted May 3 to issue $20,000 bonds for grading and paving.

Providence, R. I.—Bids will be received June 7 by the State Bd. Pub. Roads, Providence (John H. Edwards, Chmn.) for constructing sections of State Highways in the following towns: Warwick, about 5,280 ft.; Portsmouth about 2,640 ft.; Middletown, 4,500 ft.; Tiverton, 2,640 ft. Narragansett, 5,280 ft.; East Providence and Barrington, about 10,560 ft.

**Seattle, Wash.*—The following are the bids opened May 13 by the Bd. of Pub. Wks. for concrete sidewalks on Wallingford Ave. and other streets: (bidders all of Seattle) Thorsvig & Lindlard, $51,723; Coast Concrete Co., $51,410 (awarded contract); Hans Pederson, $53,902, and McAdam & Cannon, $59,423. The detail bid of the successful bidder, the Coast Concrete Co., is as follows: 5,000 cu. yds. earth work, 15 cts.; 480 ft. curb, etc., $14; 150 ft. crosswalks, $14; 41,000 sq. yds. concrete sidewalks, 93 cts.; 210 sq. yds. alley crossings, concrete, $1, and 5,000 lin. ft. 3-in. sewer pipe (drain), 10 cts.

The City Engr. is stated to have estimated the cost of regrading 3d and 4th Aves. at $230,000.

Tacoma, Wash.—The City Council is stated to have passed an ordinance providing for the paving with asphalt a portion of Jefferson Ave. and S. 17th St.; also a resolution providing for the paving of a portion of Division St. with asphalt.

**Bluefield, W. Va.*—The contract for paving Princeton Ave., 10,600 sq. yds. (bids opened May 22) has been awarded to Pfaff, Ringwald & Smith, of Chillicothe, O., at $1.91 per sq. yd. for Peebles block, of which there will be two-thirds, $1.89 for Portsmouth block, one-third. It will have a 6-in. hydraulic concrete base, 1½-in. sand cushion, Portland cement grout filler and No. 6 paving pitch expansion joints. Engineer, Geo. H. Hill, Bluefield.

**Wellsburg, W. Va.*—Rinehart Bros., of East Liverpool, O., have secured the contract for paving 14 squares of streets, with brick, on a gravel foundation, for about $21,000.

La Crosse, Wis.—It is reported that bids will be received until June 17 by the Bd. Pub. Wks. (H. J. Beckwith, Chmn.), for the following work: 51,503 sq. yds. macadam; 3,204 lin. ft. combination cement curb and gutter, 1,609 sq. ft. concrete and 3,360 cu. yds. grading.

**Dunville, Ont.*—J. W. Holmes, City Clk., writes that the contract for 20,000 sq. ft. of cement concrete walks (bids opened May 17), has been awarded to The Silica Barytic Stone Co., of Ingersoll, at 9½ cts. per sq. ft. and for filling 45 cts. per cu. yd.

Lindsay, Ont.—It is stated that bids will be received until June 1 by F. Knowlson, Town Clk., for constructing about 14,500 ft. of cement sidewalks. W. C. Way, Town Engr.

Lucknow, Ont.—It is stated that bids will be received until May 31 for constructing about 34,000 ft. of granolithic walks. P. A. Malcomson, Village Clk.

POWER PLANTS. GAS AND ELECTRICITY.

Notes Arranged Alphabetically by States.

Wilmington, Del.—Mayor Bird on May 15 suggested to the Water Comrs. the advisability of constructing an electric light plant to light the reservoirs and park lands and eventually for lighting the city.

Washington, D. C.—Bids will be received until June 6 by the Bureau Supplies and Accounts, Navy Dept., Washington for furnishing at the Navy Yards, etc., Portsmouth, N. H.; Boston, Mass.; Newport, R. I.; New York, N. Y.; League Island, Pa.; Washington, D. C.; Annapolis, Md.; Norfolk, Va. and Charleston, S. C., a quantity of naval supplies, as follows; motors; incandescent lamps; dry batteries; switches; electrical supplies; starting panel; repairing buildings; dredging; Portland cement; paving blocks; broken stone; vitrified conduit; terra cotta pipe; portable crane; rock crushing plant; brass pipe; steel castings; Jenkins & McDaniels' steam traps; pipe and fittings; etc. H. T. B. Harris, Paymaster-Gen., U. S. N.

Monticello, Fla.—The Monticello Power Co. has been incorporated with a capital of $10,000 to own and operate an electric light and power plant. Incorporators: John M. Henry, John M. Hay, Jr., and S. M. Coat.

Ft. Valley, Ga.—Bonds to the amount of $12,000 are reported sold, to be used for the construction of an electric light plant.

Hailey, Idaho.—The Cramer Electric Co. is stated to have decided to purchase the plant of the Idaho Electric Supply Co., and will furnish light for Hailey and Bellevue. A new plant will probably be installed.

Indianapolis, Ind.—The Bd. of Pub. Wks. is reported to have in contemplation the purchase of the plant of the Consumers Gas Co.

Press reports state that the Laycock Power Co. (T. B. Laycock, Pres.) recently incorporated, has ordered plans prepared for the construction of a manufacturing and central power plant. The company is reported to be in the market for boilers and electric equipment.

Frankfort, Ind.—Eugene Rush, Pres. Indiana Hydraulic Co., writes that it is proposed to construct a cement dam on Sugar Creek in Park County; probable cost of work, $160,000.

Topeka, Kan.—The Citizens' Light, Heat & Power Co. is reported incorporated with a capital of $300,000 by J. J. Heim, of Kansas City; Aronld Kalman, ,of St. Paul, Minn.; Jas. L. Wolcott, of Dover, Del., and others.

Augusta, Ky.—It is reported that bids will be received until June 1 for a 20-year electric light franchise; W. C. Wittmeier, City Clk.

Shreveport, La.—W. R. Thomas, City Secy., writes that an election will be held in Aug. to vote on issuing $150,000 bonds for the construction of a municipal electric light plant.

**Holyoke, Mass.*—R. D. Woods & Co., of Philadelphia, Pa., have secured the contract for 345 tons of 16-in. c. i. pipe, to be used by the Gas Co. in the extension from the gas works to the new gas holder, at $26.85 per ton.

Boston, Mass.—A bill under which the various Boston gas companies are to be consolidated as the Boston Consolidated Gas Co. was passed on May 18 in both houses of Legislature.

Gov. Douglas on May 19 signed the Boston Consolidated Gas Bill, which requires the company to file with the gas commissioners a certificate of the consolidation of the Boston gas companies by August 1, and to reduce the price of gas to 90 cts. by August 1, 1906.

Ft. Brady, Mich.—Lieut. C. S. Hoffman, Q. M., U. S. A., writes that contracts have bee awarded as follows for lighting Ft. Brady (bids opened May 3): To the General Electric Co. for a supply of transformers, wattmeters and arc lamps, $1,211; to W. L. Murdock, of Sault Ste. Marie, for interior and exterior work, $9,513, and to the Edison Sault Electric Co., Sault Ste. Marie, for current (interior) at 6.6 cts. per kw-hour and for exterior lighting $47.50 per arc light per yr.

Grand Haven, Mich.—Bids will be received June 16 by the Bd. of Pub. Wks. (Lewis A. Gorham, City Clk.) for a 75-kw alternating current generating set, consisting of engine, generator, and appurtenances and transformers, as advertised in The Engineering Record.

**Moorhead, Minn.*—H. E. Robers, City Clk., writes that the Westinghouse Machine Co., Chicago, Ill., has secured the contract for turbine generator, condensing apparatus, switchboard, etc., to be erected complete (bids opened May 1) for $18,750.

South St. Paul, Minn.—The City Council has granted A. Baumgarten, John Coates and others a franchise for an electric light plant to cost about $15,000.

Alma, Neb.—The date of opening of bids for constructing water works and an electric light plant, has been extended from June 8 to June 22, as advertised in The Engineering Record. M. A. Earl, Consulting Engr., Chicago, Ill.

Wisner, Neb.—The citizens are reported to have voted to issue $9,000 bonds for a municipal lighting plat.

New York, N. Y.—Bids will be received until June 5 by C. B. J. Snyder, Supt. School Bldgs., for repairs, alterations and additions to the electric bell systems in School 7, 9, 16 and 45, Boro. Manhattan also in School 27, Boro. of Bronx.

The Independent Gas Light Co., of the City of New York, has been incorporated; capital, $50,000. Directors: C. E. Marling and Roger Lewis, of New York; Wm. M. Allison, of Brooklyn.

New York, N. Y.—The City of New York is stated to have purchased property on Vernon Ave. and Division St., Long Island City, on which it is proposed constructing an electric light plant for the boroughs of Brooklyn and Queens. Another plant will be constructed on Ave. A and the East River, Manhattan Boro., and the two plants will be connected under the river; it is proposed to light with electricity all the streets, bridges, public offices and parks.

Brooklyn, N. Y.—The Roxborough Gas Light Co., of Brooklyn, has been incorporated; capital, $50,000. Directors: J. H. Delany, T. T. Sweeney and J. J. Farrell, of Brooklyn.

*The following are the bids opened May 22 by C. B. J. Snyder, Supt. School Bldg., N. Y. City, for installing electric equipment in school 147, Brooklyn Boro.: Fred. Pearce Co., $24,866; Reis & O'Donovan, $24,986; Peet, McAnerney & Powers, $21,977; W. M. Sheehan & Co., $23,837; Commercial Constr. Co., 1 Madison Ave., N. Y. City, $21,885 (awarded contract).

**Long Island City, L. I., N. Y.*—T. Fred Jackson, 592 Columbus Ave., N. Y. City, has secured the contract for electric equipment of School No. 4, Queens Boro. (bids opened May 22) for $7,967.

Jamaica, L. I., N. Y.—Bids will be received until June 5 by C. B. J. Snyder, Supt. School Bldgs., New York City, for installing electric equipment in School 82, Jamaica

Niagara Falls, N. Y.—The International Power & Transmission Co., of Niagara Falls, has been incorporated, with a capital of $2,000,000 to supply electricity for light, heat and power purposes. Directors: S. P. Franchot, H. Findlay and others, of Niagara Falls.

The Niagara & Eastern Power & Transmission Co., of Niagara Falls, has been incorporated; capital, $2,000,000. Directors: H. B. Lodi and J. D. Drayton, of Niagara Falls, A. H. Hinman, of Buffalo.

Potsdam, N. Y.—The Northern Power Co. has been incorporated with a capital of $100,000, by C. H. Tappan, of Potsdam, and others. This is reported to be a reorganization of the Hanawa Falls Water Power Co., which has a plant on Racquette River at Potsdam.

Albany, N. Y.—Two companies were incorporated May 11 for the purpose of manufacturing and furnishing gas and electricity, with the whole State as their field. The companies are the General Public Service Corporation and the Universal Service Co., the former with a capital of $2,000,000 and the latter with a capital of $100,000. Directors: Fred. H. Cowden, Wm. C. Dreyer and Saml. H. Gainsborg, all of New York City. The articles name every county, city, town and village in the State as a possible field.

Empire Transmission Co., Albany, has been incorporated by J. P. Brooks and W. J. Hough, of Albany, and others.

Ft. Totten, Willets Point, N. Y.—Bids will be received by Capt. Geo. H. McManus, Constructing Q. M., U. S. A., June 2, for electric light fixtures in 7 buildings at this Post, as advertised in The Engineering Record.

Buffalo, N. Y.—The General Transmission Co. of Buffalo has been incorporated to furnish electricity for lighting, heat and power throughout the State; capital, $15,000,000. Directors: J. D. Ferris and B. L. Moore, of Buffalo, Hugh Taylor, of East Aurora, and others.

The Buffalo & Montauk Co., of Buffalo, has been incorporated to supply electricity; capital, $2,000,000. Directors: Hugh Taylor, of East Aurora; B. L. Moore and A. P. Harks, of Buffalo.

The Niagara Gorge Power Co., of Buffalo, has been incorporated to supply electricity; capital, $2,000,000. Directors: J. T. Jones, J. A. Jones and others, of Buffalo.

Poughkeepsie, N. Y.—The Dutchess Gas & Electric Co., of Poughkeepsie, has been incorporated; capital, $25,000. Directors: A. E. Seibert and Jas. Cochran, of Brooklyn; W. R. Maloney, of Poughkeepsie.

Minetto, N. Y.—The Minetto Light, Heat & Power Co., of Minetto, has been incorporated; capital, $20,000. Directors: C. B. Benson, of Minetto; D. P. Page and T. A. Page, of Oswego.

White Plains, N. Y.—The Homans Light, Heat & Power Co. is reported incorporated with principal office at White Plains, and a capital of $250,000, to locate gas, electric light, water, power and heating plants throughout the State. Directors: Martin S. Watt, 62 W. 39th St., N. Y. City; Wm. P. Homans, 1730 Bway., N. Y. City, and others.

Oswego, N. Y.—The following are the bids opened by the Water Dept. May 18 for electrical apparatus: Stanley Electric Mfg. Co., Pittsfield, Mass. (3 bids), $15,485, $13,338 and $15,177; the Bullock Electric Co., Cincinnati, O., $12.787; Westinghouse Electric & Mfg. Co., Pittsburg, Pa., $13,690; J. M. Roman Co., New York, $17,625; Bellman & Sandford, New York (3 bids), $15,490, $16,892 and $17,890; and General Electric Co., Schenectady, $14,114.

Burlington, N. C.—The citizens are reported to have voted to issue $10,000 bonds for improving the electric light plant.

Wilson, N. C.—L. S. Randolph, Blacksburg, Va., has been selected to prepare plans, specifications and estimates for a gas power plant and electrical distribution of same.

Kenton, O.—Kerlin Bros., of Toledo, are stated to have purchased the plant of the Kenton Gas & Electric Co., it is reported that $50,000 will be expended in improvements.

Fremont, O.—The Fremont Light & Power Co. will develop the water power on Sandusky River, near Fremont, and have retained H. von Schon, of Detroit, Mich., as consulting engineer.

Youngstown, O.—The Youngstown Gas & Electric Co. is reported to be preparing plans for enlarging the power plant on North Ave.

Springfield, O.—The Peoples' Light, Heat & Power Co. is stated to have on May 20 awarded contracts as follows: 4 boilers to the Heine Safety Boiler Co., of St. Louis, Mo.; electric machinery, including generators, one 19-panel switchboard, 100 arc lights for commercial use and 400 new street arc lights to the Westinghouse Electric Mfg. Co., of Pittsburg, Pa., 4 engines of 400 h.p. ea. and two 50 h.p. exciter engines to the Westinghouse Machine Co., of Pittsburg; a radial brick stack, 150 ft. high and 10 ft. diam. to M. W. Kellogg & Co., of New York, N. Y., one 20-ton crane to the Case Mfg. Co., of Columbus; 2 feed pumps to the Dean Pump Co., of Indianapolis, Ind., and the heating plant to A. J. Stahl, of Lockport, Ind.; total cost about $150,000.

Connellsville, Pa.—The Fayette County Gas Co. is stated to have decided to construct a pipe line from Flatwoods to supply Vanderbilt, East Liberty and Dickerson Run with gas.

Selingrove, Pa.—Geo. W. Wagenseller, of Middleburg, Secy. Middlecreek Electric Co., writes that the date of opening of bids for constructing a complete water power electric plant, 700 h. p. on Middlecreek and Pennscreek, 2 miles south of Selinsgrove, has been extended from June 1 to about June 15. Bids can be made on part or all of work.

Philadelphia, Pa.—The City Council on May 18 voted to lease the city's gas works to the United Gas Improvement Co. for a term of 75 years for the total sum of $25,000,000, the money to be paid in various amounts before the end of 1907.

Hawley, Pa.—Stanley Gaines, Secy. and Mgr. Hawley Electric Light & Power Co., writes that bids will be received May 31 for rebuilding the electric light plant recently destroyed by fire; probable cost of work proposed $13,000.

Tiverton, R. I.—A charter is reported to have been granted to the Tiverton Gas Light Co. Wm. Hindle, Treas.

Aberdeen, S. D.—Bonds to the amount of $40,000 are reported sold to be used for the construction of an electric light plant.

Parsons, Tenn.—L. A. Rains and J. W. Fuller are reported interested in the construction of an electric light plant.

Wise, Tenn.—W. J. Jones is reported interested in the construction of an electric light plant.

Chattanooga, Tenn.—The City Council on May 15 passed ordinances granting C. E. James and J. C. Guild a franchise to extend the wires all over the city.

Wauwatosa, Wis.—J. M. Harrison, of Milwaukee, is stated to have been selected by the County Bd. Com. on Pub. Bldgs. to prepare plans and estimates for a central heat, light and pumping station for Wauwatosa.

Toronto, Ont.—The Private Bills Com. of Legislature on Feb. 12 is stated to have authorized the city to generate electricity at its water works plant at the island and furnish light and power there.

Ottawa, Ont.—The citizens are reported to have voted May 18 to purchase the plant of the Consumers Electric Co. at a cost of $200,000.

Regina, N. W. Ter.—Bids will be received until June 19 by the City Corporation (J. Kelso Hunter, Secy.-Treas.) for $160,000 electric light bonds.

ELECTRIC RAILWAYS.

Notes Arranged Alphabetically by States.

San Bernardino, Cal.—Seth Hartley, of Colton, is reported to have in contemplation the construction of an electric railway from Rialto to San Bernardino.

The San Bernardino Valley Traction Co. also has under consideration a proposal to build an electric line between San Bernardino and Rialto.

**Items marked thus give the names of parties awarded contracts.*

Los Angeles, Cal.—The Los Angeles Interurban Ry. Co. is reported to have for a line from Avenue 20 in East Los Angeles, paralleling the Glendale branch of the Salt Lake Road until the large Glassell ranch is reached, and through the ranch to Eagle Rock.

San Francisco, Cal.—The Ocean Shore Ry. Co. is stated to have been organized, with a capital of $3,000,000 to construct an electric railroad 83 miles in length, extending from San Francisco to Santa Cruz. The proposed electric road is to start from the China Basin in San Francisco and follow Islais Creek to Ocean View, where it will pass under the Suthern Pacific Railrad tracks, passing through Halfmoon Bay. A. D. Bowen, Burke Corbet and others are reported interested.

Oakland, Cal.—The Oakland Traction Consolidated is stated to have been granted a franchise to build an electric railway from the eastern boundary line of Oakland, and over a private right of wa yto Oakland Ave.; also from the northern boundary line of Oakland along College Ave. to Alcatraz Ave.

San Jose, Cal.—A resolution is reported to have been passed granting a franchise to build an electric railway from some point on the Monterey Bay through Watsonville and San Juan to Hollister, as applied for by W. W. Gibson, of San Francisco.

Santa Ana, Cal.—It is stated that right of way is being secured for the proposed new branch of the Pacific Electric Railway between Huntington Beach and Santa Clara. It is stated that the Los Angeles-Santa Ana line will be in operation by Oct. 1, and that work will then be commenced on the extension of lines from Huntington Beach to connect with Santa Ana and New Port. The line from Los Angeles to Santa Ana will pass through Talbert and take a direct line to the point where the Los Angeles line crosses 5th St. Here the two branches will unite.

Stockton, Cal.—The Sacramento & Southern R. R. Co. is reported incorporated by I. W. Hillman, Jr., Chas. Holbrook, C. A. Harp and J. C. Kirkpatrick, with a capital of $3,000,000, to construct and maintain an electric road from Sacramento to Stockton, with a branch line to Walnut Grove, to Antioch and to Woodbridge.

Rockport, Ind.—The Indianapolis & Ohio Valley Electric Ry. Co. is reported to have decided to construct an electric railway through Grandview, St. Meinrod, Ferdinand and over the old Indianapolis Southern route. J. H. Larimer, pres.

Shelbyville, Ind.—Chas. W. Kelly, of Jeffersonville, is stated to have begun a preliminary survey for an electric railway to be built at once by the Shelbyville & Ohio River Traction Co. The proposed line is about 57 miles in length, and is to run from Shelbyville to Carrollton and through Eminence, New Castle, Chapellsburg and Milton. T. H. Leber, Geo. W. Young, of Eminence, are reported interested.

Council Bluffs, Ia.—A party of surveyors in charge of J. W. Blanchard & Son, of Council Bluffs, are reported to be surveying for an electric railway to run east of Council Bluffs through Treynor and Carson. The line will be about 23 miles long if constructed to either of the two points mentioned.

Des Moines, Ia.—It is stated that the Des Moines City Ry. Co. will construct a line north along Polk Boule., from the Ingersoll line to the University line, this summer.

Alexandria, La.—T. G. Bush, of Mobile, Ala., is stated to have received a franchise to construct and operate an electric street car line in Alexandria.

*Monroe, La.—The City Council is stated to have awarded the contract for the construction and equipment of the electric street railway to the Western Electrical Contsr. Co., of St. Louis, for $100,000.

Gretna, La.—The Police Jury of Jefferson Parish is stated to have granted a franchise to Lehigh Carroll and Lynn H. Dinkins for the construction of a street railway.

Benton Harbor, Mich.—Right of way is stated to have been secured by the St. Joseph River Traction Co. for an electric railway between Benton Harbor and Kalamazoo.

Owosso, Mich.—It is stated that J. W. Thick and C. D. Cooper, of Detroit, are looking up the electric railway situation in Owosso for Detroit and St. Louis capitalists, and that they propose building a line from Pontiac to Owosso and north to Saginaw.

Kansas City, Mo.—Surveys are reported as being made for an electric railway from Kansas City to Leavenworth under the direction of Wm. R. Ryers.

Havre, Mont.—Dr. Ernest Crutcher, of Great Falls, is reported to have secured a franchise for a system of electric railways in Cascade County.

New York, N. Y.—The Rapid Transit Comn. is stated to have on May 18 rejected the proposition to construct a moving platform crosstown subway in 34th St. and adopted plans proposed by Metropolitan interests, to construct a tunnel under the East River from Manhattan to Long Island City. This crosstown subway and tunnel as approved by the commission will extend from 11th Ave. in Manhattan Boro. to Jackson Ave. and 5th St. in Long Island City, a point beside Newtown Creek, which divides Long Island City from Williamsburg. The road will have four tracks across Manhattan and two tracks under the river and in Queens.

Syracuse, N. Y.—The Syracuse & Suburban R. R. Co. is reported to have announced that the project of extending the railroad to Cazenovia Lake, 21 miles from Syracuse, has been successfully financed. It is expected that construction work will begin this year.

Steubenville, O.—Albert Ferguson, of Pittsburg, is reported to be interested in the promotion of a line to extend from Georgetown to Hookstown and Frankfort Springs.

Hamilton, O.—The Cincinnati, Dayton & Toledo Traction Co. is stated to have announced important improvements to the Hamilton city system. Trackage on several streets will be abandoned and several miles of new roads will be built and the entire city system will be double-tracked.

Cincinnati, O.—Henry Burkhold is reported to have in contemplation the construction of an elevated road, starting at 5th and Vine Sts. and taking a northerly direction to Norwood.

Shawnee, Okla. Ter.—A franchise is stated to have been granted to Alfred Hart, Pres. Exchange Bank, Tecumsch, with the proviso that the promoter shall commence construction of a line to Shawnee within 90 days. The two cities are only a short distance apart, and the new line will connect with the Shawnee Electric Ry.

Philadelphia, Pa.—In an ordinance passed by City Coouncils the Frankford & Southwork Philadelphia City Passenger R. R. Co. is stated to have been authorized to construct a new line beginning on Oxford Road, at the intersection of Frankford Ave., extending along Oxford Road to the intersection of the old Second St. Pike, connecting with the Olney and Fox Chase Division.

Ft. Worth, Tex.—The Wildman, Central & Wichita Mountains Electric R. R. Co. is stated to have announced that the work of securing right of way for the first 50 miles of the road will commence soon. It is the intention eventually to construct 100 miles of road through the Wichita Mountais starting from Lawton. Geo. R. Ray, of Waldman, Pres., and Capt. E. M. Tucker, of Dallas, Dir.

Staunton, Va.—The Virginia Valley Traction Co., H. B. Sproul, Pres., Staunton; Frank Clemmer, Vice-Pres., Middlebrook; H. G. McGary, Sec. and Treas., Middlebrook, is reported incorporated, with a capital of $25,000, to maintain and operate a railroad or railroads to be operated by steam, electricity or any other kind of motive power.

Davenport, Wash.—The Big Bend Traction Co., which proposes to construct a line from Davenport northward to the Columbia River, is reported organized by John Plummer is reported interested.

It is stated that the Spokane & Big Bend Traction Co. contemplates constructing an electric railway. W. H. Sawyer, J. W. Fry and Chas. Turner.

The Adams County Transit Co. is reported organized. A right of way from Davenport to the rived was donated for the propoosed route, and a franchise was granted by the city of Davenport.

Havana, Cuba.—The Havana Central Ry. Co. is reported organized with Edwin Hanson, of Montreal, Que., Pres., and Wm. L. Bull, of New York, N. Y., vice-pres., to construct 120 miles of road, all radiating from the city of Havana and extending through about 50 towns.

RAILROADS.

Notes Arranged Alphabetically by States.

Bay Minette, Ala.—The Navy Cove Harbor & R. R. Co. is reported incorporated, to build, equip and operate a railroad in Baldwin County, from Foleyton Station to deep water at Ft. Morgan; capital, $500,000, and headquarters will be at Bay Minette. Incorporators: Chas. Barclay, Chas. Schimpf, T. C. Hand and others.

Alaska.—Jas. Bazard, J. C. Jeffrey and Wm. Wray, of Seattle, Wash., are reported to be trustees of the company incorporated May 13 for the purpose of building a railway north from near the end of Martins Island, in Alaska; capital $2,000,000. The company will be known as the Alaska Ry. & Terminal Co.

Columbus, Ga.—The Columbus Northern Ry. Co. is reported incorporated to construct a line from Columbus, Ga., through the counties of Muscogee, Harris, Meriwether and Troup, either to West Point or LaGrange, a distance of about 60 miles. Capital, $100,000. Incorporators: Chas. L. Davis, of Meriwether; O. C. Bullock, T. W. Bates, Arthur Bussey and others, all of Columbus. It is said this new line will be operated in connection with the Atlanta, Birmingham & Atlantic, which is to run from Brunswick, Ga., and from Atlanta to Birmingham, Ala.

Augusta, Ga.—The Savannah River R. R. Co. is reported incorporated, to construct a line from Augusta to Clyo, a distance of about 90 miles, in a general southeast direction, through the counties of Richmond, Burke, Screven and Effingham, to and from Augusta to Bath, Waynesboro, Sylvania and Clyo; capital $100,000. Principal office to be in Augusta.

Toluca, Ill.—The Toluca, Marquette & Southern R. R. Co. is reported incorporated to construct a line from Toluca, in a southerly direction through the counties of Marshall, Woodford, McLean, Dewitt, Macon, Christian, Shelby, Montgomery, Fayette, Marion, Jefferson, Franklin, Williamson, Union, Pulaski, to Thebes; capital, $700,000. Incorporators: Wm. W. Twist, Henry Duggan, and James Mannix of Toluca, and Chas. J. Devlin of Spring Valley.

Morganfield, Ky.—The Morganfield & Atlanta R. R. Co. is reported incorporated by T. B. Young, A. W. Mason and J. K. Waller, to construct a line from Morganfield to Providence; capital, $50,000.

New Orleans, La.—The Colorado Southern, New Orleans & Pacific R. R. Co. is reported incorporated with a capital of $5,000,000 to build a line from some point on the Mississippi River at or near New Orleans to the western boundary of the state through Texas to the Pacific Ocean. Incorporators: F. B. Haynes, John J. Gannon, S. P. Walmsley and others.

The New Orleans & Great Northern R. R. Co. is reported incorporated with a capital of $25,000,000 to build a railroad direct from New Orleans to Memphis, and up the Pearl River to Jackson, Miss., and from Jackson to Tennessee. Incorporators: Frank H. Goodyear, Buffalo, N. Y., I. E. Enochs, Jackson, Miss., Martin E. Olmstead, Harrisburg, Pa. and others.

Shubuta, Miss.—The Shubuta & Southwestern R. R. Co. is reported incorporated. This is a branch or spur line running from the Mobile & Ohio main line at Shubuta, and proposes to run thence to a connection with the New Orleans & Northeastern; capital, $25,000. F. H. Kaupp, Pres.; J. H. Griffin, Secy.

Brooklyn, N. Y.—Mayor McClellan is stated to have approved the bill changing the law relating to the Brighton Beach grade crossing improvement. The bill makes several changes along the right of way, authorizes the railroad company to acquire property by voluntary purchase, enables it to buy strip of land adjoining the tracks, instead of building retaining walls and authorizes the city to bear its share of the expense incident to some of the proposed improvements. One-half the cost of the total improvement, which is the part the city is supposed to pay. The city is now authorized to increase its expenditure to $1,000,000.

Morgantown, N. C.—The Charleston, Virginia & Ohio River R. R. Co. is reported incorporated, with principal office at Morgantown, and a capital of $2,200,000; to construct a road from Charleston, S. C., 130 miles to Norton, Va. There is to be 140 miles of road in North Carolina, 70 miles in Tennessee and 50 miles in Virginia. Incorporators: W. C. Ervin and H. L. Millener, Morgantown; Robt. Regney, New York, N. Y. and others.

Starkweather, N. D.—The stockholders of the Farmers' R. R. Co. are stated to have decided to extend the road a distance of 35 miles northwest from Starkweather, the present terminus; they have also decided to bond for $450,000.

Cincinnati, O.—The Cleveland, Cincinnati, Chicago & St. Louis Ry. Co. (G. W. Kittredge, Ch. Engr., Cincinnati) is reported to have under coonsideration extensive improvements to include terminal improvements at Indianapolis, Cincinnati and Columbus; a new union station at Springfield, O., and the road between Cincinnati and Dayton, will be, to a large extent, double-tracked; there will also be some important work done on the division between Cincinnati and Indianapolis.

Youngstown, O.—The stockholders of the Youngstown & Southern R. R. Co. are stated to have decided to build the line at once to East Liverpool.

Panama.—Plans for the enlargement of the terminal and dock facilities at Colon and Panama, and the double-tracking and re-equipment of the road, entailing an expenditure of approximately $2,000,000, are reported to have been approved by the board of directors of the Panama R. R. Co., at a meeting in New York, N. Y., on May 16. J. Edw. Simons, Pres., 24 State St., New York, N. Y.

Chamberlain, S. D.—The Chicago, Milwaukee & St. Paul Ry. Co. (D. J. Whittemore, Ch. Engr., Chicago, Ill.) is reported to have decided to commence the construction of a line from both Chamberlain and Evarts, in South Dakota, to the Pacific Coast. The Missouri will be bridged at two places, and the two west-bound lines will come together in central Wyoming and a single track will be extended to the Coast, with terminals at Seattle and Bellingham Bay.

Madison, Tenn.—The Madison & Goodlettsville R. R. Co. is reported incorporated, with a capital of $10,000, by Jas. Geddes, John Bell Keeble, E. B. Duval and others, to build a railway from a point on the main line of the Louisville & Nashville R. R., near Madison Station, to a point on the Henderson division at or near Goodlettsville.

Chattanooga, Tenn.—Local press reports state that in addition to the Stevenson extension and the construction of the tunnel through Lookout Mountain, the Southern Ry. Co. (W. H. Wells, Engr. of Construction, Washington, D. C.), will shortly add trackage covering 30 acres to the Citico yard, new shops and terminal facilities, which will probably cost several millions of dollars and will make Chattanooga the central shipping point on the western division of the system.

The Chattahoochee Valley R. R. Co. (L. Lanier, Pres., West Point, Ga.,) is reported to have decided to extend its system about 60 miles to a convenient point in Car-

*Boston, Mass.—The following are the bids opened May 16 by the Boston Transit Comn. for constructing Sect. 5 of the Washington St. subway: (bidders of Boston, unless otherwise mentioned). (1) The H. Gore Co., 54 Kilby St.; (2) Jas. J. Coughlan Const. Co., 19 Worthington St.; (3) Gow & Palmer, Inc., 50 Congress St.; (4) Hugh Nawn Cont. Co., 82 Savin St.; (5) Manufacturers' Contr. Co., 1005 Market St., Wilmington, Del.; (6) Metropolitan Contr. Co., 95 Milk St.; (7) Coleman Bros., 15 Court Sq. (awarded contract).

	52,000 cu. yds. excav.	11,000 cu. yds. of concrete (*b*).	11,000 cu. yds. of concrete furnished by com. (*bb*).	500 cu. yds. of concrete around steel beams (*c*).	Hauling and Place 500 cu. yds. concrete furnished by com. (*cc*).	100 cu. yds. brick masonry.	Lay 540 lin. ft. 24 in. vitr. pipe.	Lay 170 lin. ft. 18 in. vitr. pipe.	Lay 1,050 lin. ft. 15 in. vitr. pipe.	Lay 400 lin. ft. 12 in. vitr. pipe.	Lay 400 lin. ft. 6 in. and 8 in. vitr. pipe.	Lay 300 lin. ft. 3 in. and 4 in. vitr. pipe.	300 tons steel and iron weight less than 6 lbs. per lin. ft.	250 tons steel and iron weight 6 lbs. or more per lin. ft.	3,000 sq. yds. of coating of Portland cement mortar.	100 cu. yds. grout. 5,000 sq. yds. pitch or asphalt.	40,000 sq. yds. tarred felt.	Underpin., support., and protect. bldgs.	Total, omitting items *bb* and *cc*.	Total, omitting items *b* and *c*.
1	$6.50	$14.00	$9.00	$15.00	$10.00	$20.00	$0.75	$0.65	$0.50	$0.45	$0.20	$0.15	$20.00	$20.00	$0.75	$35.00	$0.40	$0.20	$640,595	$583,095
2	6.50	13.00	8.00	15.00	10.00	20.00	1.50	1.00	1.00	.50	.40	.40	20.00	18.00	.75	33.00	.50	.25	613,560	556,060
3	6.00	14.50	9.00	16.00	11.00	18.00	1.00	.80	.60	.50	.30	.20	18.00	15.00	.75	25.00	.50	.25	564,386	501,386
4	5.50	11.00	7.50	15.00	10.50	20.00	2.00	1.00	1.00	1.00	1.00	.70	12.00	15.00	.60	25.00	.30	.20	522,960	482,210
5	5.15	12.50	7.50	15.00	10.00	18.00	1.00	1.00	.75	.75	.30	.20	14.00	12.00	.45	25.00	.40	.20	517,627	460,127
6	4.95	10.90	6.25	15.00	7.00	15.00	1.50	1.50	1.50	1.50	1.50	1.00	15.00	18.00	.50	25.00	.50	.29	509,540	454,390
7	5.25	11.00	6.75	14.00	9.50	20.00	1.50	1.00	.75	.60	.40	.20	20.00	15.00	.50	25.00	.40	.20	483,977	434,977

**Items marked thus give the names of parties awarded contracts.*

roll County; capital stock has been increased from $10,000 to $100,000.

Jefferson, Tex.—The County Comrs. are stated to have granted the application for a franchise to the Port Arthur & Houston Short Line, to build through Jefferson. Required terminal facilities at Port Arthur are granted.

Brattleboro, Vt.—The directors of the West River R. R. Co. are reported to have voted to issue $75,000 bonds to be used for double tracking and otherwise improving the narrow gauge railroad bet. Brattleboro and South Londonderry, a distance of about 35 miles.

Edmonds, Wash.—The Edmonds & Eastern Ry. Co. is reported organized to build a line from Edmonds to Monroe; capital $400,000. Incorporators: Geo. O. Smith, Frank M. Stanley, C. A. Magunson and others, all of Seattle.

Santiago, Chili.—The Government is reported to have decided to issue bonds to build a system of railroads.

PUBLIC BUILDINGS.

Notes Arranged Alphabetically by States.

Montgomery, Ala.—Thos. M. Owen, Secy. State Capitol Comn., writes that plans will be received until July 5 for extension of the Capitol, by the erection of 2 annexes or wings, one on the south and the other at the north side, the wings to be separate from the main building, but connected by a corridor or like device. The south wing only is to be erected at this time at a cost of $70,000. Memoranda for architects can be seen at the office of The Engineering Record, 114 Liberty St., New York, N. Y.

San Francisco, Cal.—It is reported that the erection of a hospital to cost about $1,000,000 is under consideration.

Patton, Cal.—Bids will be received June 15 by the Bd. Mgrs. (Lyman M. King, Secy.) for furnishing materials and erecting an east wing addition to the Southern California State Hospital. Bids to be submitted separately on the following: Masonry work, iron work, carpentry, plumbing and gasfitting and heating; probable cost, $60,000. Hudson & Munsell, Archts., Stimson Bldg., Los Angeles.

**Washington, D. C.*—Ellicott Woods, Supt. U. S. Capitol Bldg. & Grounds writes that the contract for structural steel work in connection with construction of 2 floors of the office building House Representatives (bids opened May 17) has been awarded to American Bridge Co., New York, N. Y., for $36,500.

Washington, D. C.—See "Power Plants, Gas and Electricity."

Bids will be received on July 1 by the Municipal Bldg. Comn. for the superstructure of the municipal building, as advertised in The Engineering Record.

Bids will be received until June 3 by the Comrs. D. C. (Henry B. MacFarland, Chmn.) for constructing the east wing, workhouse for males (exclusive of cells), Washington Asylum Grounds, 19th and E Sts.

Chicago, Ill.—Dr. L. Blake Baldwin, it is reported, has purchased the 7-story Hotel Normandie, at 339 Michigan Ave., and will remodel same for the Samaritan Hospital, the cost to be about $150,000.

Ottawa, Ill.—It is stated that plans have been prepared for a sanitarium which it is proposed erecting at a cost of $20,000. Dr. J. W. Pettit is reported interested.

**Jacksonville, Ill.*—V. Jobst & Son, of Peoria, have secured the contract for erecting the U. S. Post Office (bids opened May 1) for $42,180.

**Lafayette, Ind.*—John Chew, of Lafayette, it is reported, has received the contract to erect the widows' home at the State Soldiers' Home, the cost to be about $38,600. Lane-Pike Co., of Lafayette, have the contract for the plumbing of same at $2,600.

Goshen, Ind.—Press reports state that bids will be received until June 8 by the Bd. Co. Comrs. for $50,000 court house improvement bonds.

**Vinton, Ia.*—A. H. Turner, Co. Aud., writes that the contract for erecting a 2-story and basement stone court house (bids opened May 16) has been awarded to Geo. Rickman & Sons Co., of Kalamazoo, Mich., for $73,530.

Council Bluffs, Ia.—J. D. Edmundson, of Des Moines, it is stated, has offered the Women's Christian Assoc. $40,000 with which to erect a hospital.

Ft. Riley, Kan.—Bids will be received until June 8 by Capt. Leon S. Roudrez, Constr. Q. M., U. S. A., Ft. Riley, for constructing a squadron blacksmith shop.

Troy, Kan.—The Co. Comrs. are considering plans received for the proposed court house, which is to be erected at a probable cost of $40,000.

Ft. Scott, Kan.—It is reported that bids will be received until June 9 by the Bd. Co. Comrs., for erecting a steam heating plant in the court house and jail; Chas. E. Holstein, Co. Clk.

Louisville, Ky.—It is reported that bids are now being received by the Public Library Trus. for a free public library. Architects, Pitcher & Tachan, 32 E. 28th St., New York.

Lexington, Ky.—It is stated that plans have been accepted for the Samaritan Hospital, which is to be erected on S. Limestone St. The building is to be 4 stories high, equipped with sanitary and improved plumbing apparatus and ventilating and heating and is to cost $50,000.

Gretna, La.—A site has been selected on which it is proposed erecting the court house, plans for which are to be prepared by F. B. Hull, of Jackson, Miss., and to be submitted to the Court House Comn. on June 2.

Baltimore, Md.—Bids will be received by Col. W. A. Jones, Corps Engrs., U. S. A., Baltimore, June 19, for furnishing material and erecting a keepers' dwelling at Cape Lookout Light Station, N. C., as advertised in The Engineering Record.

Boston, Mass.—An act has passed both branches of the City Council appropriating $100,000 for the establishment of a relief hospital in the East Boston Dist.

Owosso, Mich.—The following are the bids opened May 23 by the Superv. Archt., Treas. Dept., Washington, D. C., for constructing complete U. S. Post-Office at Owosso: Burnett & Baldwin, Corunna, $25,300; Geo. Rickman's Sons Co., Kalamazoo, $29,400; L. O. Miller & Co., Middletown, Ind., $38,000; W. J. Turner Co., Chicago, Ill., $35,475; Northern Constr. Co., Milwaukee, Wis., $34,595; E. W. Reid & Co., Flint, $36,190; Chas. Hoertz & Son, Grand Rapids, $34,765.

Jackson, Miss.—It is reported that bids are wanted until June 7 for remodeling the State Insane Hospital; for further information address J. Fitzgerald, Steward.

*C. M. Rubush, of Meridian, it is stated, has received the contract to erect the Mississippi Methodist Orphanage at $33,000.

**Columbia, Mo.*—Latimer & Bennings, of Kansas City, have secured the contract for erecting the U. S. Post Office for $27,638.

Kansas City, Mo.—Archt. Fred. C. Gunn, 208 Grand Ave., writes that the city has just allowed a further fund of $125,000 for hospital purposes, making a total of $350,000; plans will be completed at once.

It is reported that bids will be received until June 7 by the Bd. Fire Comrs. (Jos. Weston, Chmn.) for erecting a fire engine house at 31st and Holmes Sts., and also at 6th and Prospect Sts.

**St. Louis, Mo.*—The Broderick-Wind Eng. Co., it is stated, has received the contract to erect the Pathological Bldg. at the City Hospital at $39,046.

Higginsville, Mo.—The Bd. of Mgrs. of the ex-Confederate Soldiers' Home has accepted the plans of M. F. Bell, of Fulton, for the new hospital and electric light plant, which is to be erected at the home at a cost of $28,000.

**St. Joseph, Mo.*—P. P. Buddy, 419 Main St., it is reported, has received the contract to erect the auditorium at $191,843.

Ft. Omaha, Neb.—It is reported tthat Maj. M. Gray Zalinski, at Omaha, Constr. Q. M. of Ft. Omaha, has received word from the War Dept. that the following brick buildings are to be constructed at Ft. Omaha: One set of field officers' quarters, 1 double captain's quarters, 3 double lieutenants' quarters, 1 set single non-commissioned staff officers' quarters, 1 quadruple non-commissioned staff officers' quarters, 1 hospital, 1 double barrack, and 1 administration building.

**Concord, N. H.*—The following are reported to be the bids received for erecting buildings, etc., at the New Hampshire State Hospital (bids received May 9), (*a*) hospital building, (*b*) storehouse, (*c*) employes' house, (*d*) 6 iron fireproof stairways: J. H. Smith, *a* $138,000; C. A. Dodge & Co., *a* $134,297; *b* $13,895; Woodbury & Leighton, *a* $132,332; *b* 10,400; Guay & Wallace, *a* $131,878; J. J. Prindiville, *a* $131,755; *b* $11,789; J. W. Bruty, *a* $124,805, *b* $14,200; Whiton & Haines, *a* $122,930 *b* $9,233; J. H. Mendell, *a* $119,372, *b* $8,734; Hutchinson Bldg. Co., of Concord, *a* $114,350, *b* $8,342 (awarded contract), *c* $9,450 (awarded contract), *d* $19,400; Head & Dowst, *a* $113,785, *b* $8,685, and C. L. Fellows & Co., Concord, *a* $111,366 (awarded contract), *b* $8,700, *c* $9,800 and *d* $18,006 (awarded contract); A. P. Knapp, *d* $18,960.

The Hutchinson Bldg. Co., Concord, is stated to have secured the contract for building an addition to the Home for Aged, for $15,800.

Belmont, Nev.—It is stated that bids will be received by the Co. Comrs. until June 5 for erecting a stone and steel jail.

New York, N. Y.—The following are the bids opened May 9 by the Superv. Archt., Treas. Dept., Washington, D. C., for the mechanical equipment of the U. S. Custom House at New York: (Bidders of New York, unless otherwise mentioned) G. A. Suter & Co., $284,000; Wells & Newton Co., $285,200; Body Equipment Co., $251,000; Francis Bros. & Gillette, $282,500; John Pierce, $261,556; L. H. Prentice Co., $336,895; S. Faith, Philadelphia, ,Pa., $272,500; J. M. Williams, Louisville, Ky., $340,986; Lynch & Woodward, Boston, Mass., $309,716; J. T. Finn Co., $270,000; Evans, Almirall & Co., $271,164, and New York Steam Fitting Co., $237,266.

Bids will be received until June 2 by the Dept. Pub. Charities for furnishing materials and erecting a boiler house at the City Hospital, Blackwell's Island; also to install boilers and lay steam and water supply mains at said building.

**Brooklyn, N. Y.*—Thos. G. Carlin, 215 Montague St., has secured the contract for erecting a stable at Kingston Ave. Hospital, bids opened by the Bd. of Health, N. Y. City, May 17, for $24,997.

The Park Comrs. of N. Y. City (John J. Pallas, Pres.) have decided to reject all bids received May 11 for erecting a shelter in Ft. Greene Park, Boro. Brooklyn, the lowest bid received being from the Northeastern Constr. Co. at $29,400.

Bids will be received until June 7 by the Dept. Pub. Charities, New York City (Jas. H. Tully, Comr.) for furnishing materials, erecting and competing an isolation pavilion at Kings Co. Hospital, Boro. Brooklyn.

Niagara Falls, N. Y.—Bids will be received until June 26 by Jas. Knox Taylor, Superv. Archt., Treas. Dept., Washington, D. C., for constructing complete, the U. S. Post Office at Niagara Falls.

Newburgh, N. Y.—Bids will be received by the Bldg. Com., Bd. Superv. (Geo. Mosher, Chmn.) until June 12 for erecting a jail and making additions to and alterations in the Co. Court House; probable cost $40,000. Fred M. Sneed, Archt., 56 2d St.

Oswego, N. Y.—Bids will be received on June 15 by Capt. W. M. Coulling, Q. M., U. S. A., Oswego, for constructing, etc., buildings at Madison Barracks, as advertised in The Engineering Record.

Watertown, N. Y.—D. D. Kieff, 24 Flower Bldg., it is stated, has prepared plans for an addition which the Sisters of Mercy intend erecting at a cost of $20,000.

Toledo, O.—It is reported that the Co. Comrs. are contemplating the installing of new boilers at the County Infirmary at a cost of $15,000.

Marietta, O.—It is reported that bids are wanted until June 8 for erecting a brick dormitory at the Children's Home; C. Chamberlain, Aud.

**Harrisburg, Pa.*—Weaver & Son, of Harrisburg, it is reported, have received the contract to erect an addition to Harrisburg Hospital at $54,750.

Westchester, Pa.—Bids will be received until June 28 by Jas. Knox Taylor, Supervising Archt., Washington, D. C., for constructing complete the U. S. Post Office here.

Kennett Square, Pa.—The citizens are said to be considering the erection of a hall and building for the fire department, the cost to be about $15,000.

Oil City, Pa.—The following are the bids opened May 22 by the Superv. Archt., Treas. Dept., Washington, D. C., for the construction complete of U. S. Post-Office at Oil City: Fissel & Wagner, New York, N. Y., $50,693; Genl. Supply & Constr. Co., New York, N. Y., $54,300; W. E. Spier, Washington, D. C., $56,800; Allen & Meads, Oil City, $59,500; Constable Bros. Co., Erie, $59,750; Thos Reilly, Philadelphia, $56,392; Henry Shenk Co., Erie, $61,155, and F. L. Stevenson Contract. Co., Dallas, Tex., $47,500.

**Florence, S. C.*—The Crawford Plumbing & Mill Supply Co., of Winston-Salem, N. C., has secured the contract for heating the court house and post office (bids opened May 6) for $2,225.

Pierre, S. D.—Bell & Detwiler, of Minneapolis, Minn., have been authorized by the State Capitol Comn. to prepare plans for the new capitol.

**Ft. Moultrie, S. C.*—G. A. Goodrich, of Augusta, Ga., it is stated, has received the contract to erect a bachelor officers' quarters and a company barrack at Ft. Moultrie, at a total cost of about $50,000.

Watertown, S. D.—Bids will be received June 1 by the Common Council for erecting a Carnegie Library; H. L. Harris, Secy. Library Bldg. Com.

Savannah, Tenn.—It is stated that bids will be received until May 31 by the Bldg. Com. (H. E. Williams, Secy.) for erecting a court house here.

Ft. Wright, Wash.—Bids will be received until June 15 by Capt. Edw. A. Shuttleworth, Constr. Q. M., U. S. A., for constructing, plumbing, heating and electric wiring 1 field officers' quarters, 1 double set captains' quarters, 1 8-set bachelor officers' quarters and 2 double-barrack buildings, at Ft. Wright.

Ritzville, Wash.—The Co. Comrs., it is reported, have accepted the plans of Preusse & Zittel, of Spokane, Wash., for an addition to the Court House, to cost about $15,000.

Milwaukee, Wis.—It is stated that plans are being prepared by O. C. Uehling, Wells Bldg., for remodeling the Kosciusko Armory on First Ave., the cost to be about $25,000.

Barron, Wis.—Bids will be received until June 5 by H. H. McKee, City Clk., for erecting a City Hall and fire dept. bldg.

Laramie, Wyo.—The following are the bids opened on May 11 by the Superv. Archt., Treas. Dept., Washington, D. C., for constructing the U. S. Post-Office here, not including heating apparatus: Morrison Constr. & Supply Co., Denver, Colo., $94,500; T. H. O'Niel, Denver, Colo., $94,350; S. H. Atkinson, Colorado Springs, Colo., $92,090; I. W. Percival, Salt Lake City, Utah, $112,300; W. H. Maxwell, Pierre, S. D., $79,378; J. H. Randall, Seattle, Wash., $134,552; Hastie & Dugan, Seattle, Wash., $79,710, and Campbell Bldg. Co., Salt Lake City, Utah, $90,700.

Vancouver, B. C.—Bids will be received until June 23 by the Bd. Pub. Wks., Ottawa, Ont. (Fred. Gelinas, Secy.) for erecting a Post-Office at Vancouver.

Toronto, Ont.—The erection of a hospital to cost about $1,000,000 is reported under consideration.

Montreal, Que.—Bids will be received June 1 by L. O. David, City Clk., for erecting a fire station at Boyer and Beaubien Sts.; Jos. Sawyer, Archt., 376a St. Antoine St.

BUSINESS BUILDINGS.

Notes Arranged Alphabetically by States.

San Francisco, Cal.—Bliss & Faville, Crocker Bldg.. it is stated, have have been selected to prepare plans for the 16-story fireproof building which the directors of the Bank of California intend erecting at California and Sansome Sts.

San Diego, Cal.—The National Securities Co., it is reported, intends erecting a hotel at a cost of $60,000.

Los Angeles, Cal.—Capt. John Goss, it is reported, has secured a site at 7th St. and Bway. and intends erecting a fire proof building to cost about $400,000.

Denver, Colo.—It is stated that improvements are to be made to the Brown Palace Hotel at a cost of about $250,000.

Florence, Colo.—The Odd Fellows, it is stated, are contemplating the erection of an opera house and business building, the cost to be about $50,000.

Denver, Colo.—David May, it is reported, intends erecting a department store at 16th and Champa Sts., at a cost of $600,000. F. E. Edbrooke, 510 Opera House Blk., is the archt.

Washington, D. C.—Plans are being prepared for remodeling the Scottish Rite Cathedral on G. St., at a cost of $30,000.

Boise, Idaho.—J. E. Tourtellotte & Co., Boise, it is stated, are preparing plans for a 4-story and basement building, to be erected for the Idaho Trust & Savings Co.

Payette, Idaho.—Mrs. Hattie Gilmore, it is reported, intends erecting a hotel here to cost about $30,000.

Chicago, Ill.—John H. Bradshaw, it is stated, has purchased a site at 50 Franklin St. and is contemplating the erection of a 7-story building to cost about $50,000.

Indianapolis, Ind.—Bids will be received June 3 by the Bldg. Com. (John S. Lazarus, Chmn., 127 E. Market St.) for erecting a new building for the Bd. of Trade on the present site; C. L. Stiles, Archt., Rm. 5, Claypool Bldg.

Muskogee, Ind. Ter.—It is stated that the Bd. of Directors of the Y. M. C. A. intend erecting a building at a cost of $50,000.

**Muncie, Ind.*—Fred. Illingworth, of Muncie, it is reported, has received the contract to erect the Goddard Blk. at $50,775.

Rushville, Ind.—Wm. S. Kaufman, of Richmond, Ind., it is stated, has been commissioned by the members of the Masonic Lodge to prepare plans for a 3-story brick and stone temple, 82x120 ft.

**South Bend, Ind.*—Jacob Bodaz, of Chicago, Ill., it is reported, has received the contract to erect a 6-story addition to the Oliver Hotel, to cost about $100,000.

****Items marked thus give the names of parties awarded contracts.***

Cedar Falls, Ia.—It is reported that the Cedar Falls Masonic Lodge has voted to erect a $20,000 opera house and lodge building. Address secretary.

Baton Rouge, La.—Bids will be received June 10 by L. G. Stirling, at the office of the Louisiana Fire Ins. Co., Baton Rouge, for erecting a Masonic Temple; L. M. Weathers, Co. Archts., Memphis, Tenn.

Jennings, La.—Thornwell Fay, vice-pres. of the Morgan, Louisiana & Texas R. R., it is stated, has announced that the Southern Pacific R. R. will erect a $25,000 depot here.

Oldtown, Me.—It is stated that plans are being prepared for a car barn, which is to be erected by the Bangor Ry. & Electric Co. to accommodate 50 or more cars.

**Worcester, Mass.*—S. Z. Poli, of New Haven, Conn., it is reported, has awarded the contract to furnish all the structural steel needed to alter the Crompton Blk. to the Eastern Bridge & Structural Co., of Worcester. The cost of the improvements is to be about $40,000.

Holyoke, Mass.—W. B. Reid, 280 High St., it is stated, has prepared plans for a 4-story brick building which is to be erected for M. J. Laporte at Suffolk and Railroad Sts., at a cost of $24,000.

Springfield, Mass.—Francis R. Richmond, 115 State St., it is stated, has prepared plans for the Odd Fellows' Bldg., which is to be erected on Pynchon St. by Hampden Lodge and is to cost about $35,000. For further information address Bldg. Com.

Detroit, Mich.—The erection of a hotel on the site of the Russell House, to cost about $2,000,000, is reported under consideration. Attorney H. E. Boynton may be able to give further information.

Grand Rapids, Mich.—It is stated that plans have been prepared for a $40,000 storage and warehouse which is to be erected for the Grand Rapids Brewing Co.

John Murray, it is reported, has purchased a site at Clark and Division Sts., on which he intends erecting a 5-story business building to cost $25,000.

**Battle Creek, Mich.*—M. M. Lewis & Sons, of Battle Creek, it is stated, have received the contract to erect the Grand Trunk depot on E. Hall St., the cost to be about $50,000.

Detroit, Mich.—The Michigan Agricultural Society, it is reported, has decided to erect a steel grand stand at a cost of $40,000.

**Minneapolis, Minn.*—The contract for the foundation and superstructure of the McKnight Bldg., at Hennepin Ave. and 8th St., has, it is stated, been awarded to J. & W. A. Elliott, Lumber Exchange, at $50,000.

Minneapolis, Minn.—A. L. Dorr, Lumber Exchange, has prepared plans for 3-story brick stores and hall, to be erected for H. Aldene Smith, to cost $45,000.

**St. Paul, Minn.*—A permit has been issued for a 3-story brick flat with stores for P. Schollert, to cost $30,000. Builder, John H. Donohue, Gilfillan Blk.

**Duluth, Minn.*—L. D. Campbell & Co., Lonsdale Bldg., it is reported, have received the contract to remodel the Hunter Blk. at Superior St. and First Ave. W., at a cost of about $20,000.

**Gulfport, Miss.*—O. E. Thompson, of Gulfport, it is stated, has received the contract to erect a 2-story pressed brick business building for A. E. Jordan, at 14th St. and 25th Ave., to cost $17,000, and also the contract to erect a 4-story dry goods building on 25th Ave. for Hewes Bros., the cost to be $26,000.

St. Louis, Mo.—The Catholic Knights of America, it is stated, intend erecting a headquarters building in this city, the cost to be about $300,000.

Warrensburg, Mo.—Chas. H. Harrison, it is stated, is contemplating the erection of an opera house here at a cost of about $25,000.

**Omaha, Neb.*—The Omaha & Council Bluffs St. Ry. Co. is stated to have awarded the general contract to Rockford & Gould, Paxton Blk., for car repair shops to cost $50,000. Fisher & Lawrie, Archt., Paxton Blk.

The Woodmen Circle, it is stated, has decided to erect a building here to cost about $80,000.

A building permit has been granted to the Crane Co. to erect a brick warehouse at 10th and Harney Sts., to cost about $75,000.

**Elmira, N. Y.*—E. W. Seymour & Son, of Binghamton, it is stated, have received the contract to erect an addition to Langwell Hotel, the cost to be about $40,000.

Rochester, N. Y.—It is stated that the remodeling of the Y. M. C. A. Bldg. on Court St. at a cost of $46,000 is under consideration.

It is stated that the Masons are considering the erection of a temple in this city, the cost to be about $40,000.

Charlotte, N. C.—W. F. Denney, of Atlanta, Ga., it is stated, is the archt. for a hotel which is to be erected here for the Highland Hotel Co. The building is to be a 6-story and basement structure and is to cost about $100,000.

Findlay, O.—A company is about to be incorporated to be known as the Majestic Bldg. Co., for the purpose of erecting a hotel and opera house at a cost of about $150,000. Incorporators: Dr. J. A. Kimmel, S. L. McKelvey and others. Chas. R. Stedman, Superior Bldg., Cleveland, is the archt.

Van Wert, O.—It is reported that C. E. Kendrick, of Ft. Wayne, Ind., is the archt. for a $20,000 building which is to be erected by the Central Mfg. Insurance Co.

**Cincinnati, O.*—L. P. Hazen & Co., Reading Road, it is stated, have received the contract to erect a $50,000 building for the Krell Piano Co.

The L. B. Harrison estate, it is stated, has filed plans for an 8-story brick and concrete wholesale clothing house, which is to be erected at 7th and Walnut Sts., at a cost of $100,000.

J. G. Steincamp & Bro., Mercantile Library Bldg., it is stated, is preparing plans for a $20,000 cracker bakery, which is to be erected for Kroger Grocery & Bakery Co.

Painesville, O.—It is stated that an addition is to be erected to the Y. M. C. A. building at a cost of $15,000.

**Altoona, Pa.*—P. W. Finn, of Altoona, it is reported, has received the contract to erect a theatre for I. C. Michler and a 6-story office building for Oliver Rothert, the total cost of the building to be about $175,000.

Wilkesbarre, Pa.—The Welles Bldg., on Public Square, it is reported, has been destroyed by fire.

Knoxville, Tenn.—The Masons, it is stated, intend erecting a temple to cost $50,000.

Memphis, Tenn.—Shaw & Pfeil, Planters Bldg., are stated to have been authorized to prepare plans for the construction of additional stories on Hotel Gayoso.

The Bd. of Directors of the State Natl. Bank and the Manhattan Savings Bank Trust Co., it is stated, are considering plans for the erection of a 15-story bank and office building. Plans have been prepared by Shaw & Pfeil, Planters' Bldg.

Nashville, Tenn.—A building permit has been granted to the Nashville Warehouse & Elevator Co., to erect a concrete building on the Louisville & Nashville R. R., at an estimated cost of $25,000.

Tyler, Tex.—It is stated that the Cotton Belt Ry. (M. L. Lynch, Ch. Engr., Tyler,), intends erecting a brick freight depot here to cost about $50,000.

Waco, Tex.—A $75,000 passenger station, according to reports, is to be erected at 4th and Mary Sts. by the Cotton Belt (M. L. Lynch, Ch. Engr., Tyler), and the Great Northern Rys. (J. D. Trammel, Ch. Engr., Palestine, Tex).

Corsicana, Tex.—Bids will be received until June 1 by the Bd. Trus. (C. B. Sutherland, Chmn.) for erecting a brick dining hall and a 2-story brick dormitory at the I. O. O. F. Widows and Orphans' Home; H. B. Lochhead, Archt., Corsicana.

Seattle, Wash.—Saunders & Lawton, New York Blk., it is stated, are to prepare plans for a 6-story building which is to be erected on Second Ave. by J. A. Moore at a probable cost of $400,000.

Spokane, Wash.—Preusse & Zittel, Jameson Bldg., it is stated, are preparing plans for a 3-story building, 80x80 ft., which is to be erected on Howard St. and 2d Ave. for H. J. Shinn at a cost of about $30,000.

Menasha, Wis.—It is reported that Wm. Waters of Oshkosh is preparing plans for a $25,000 hotel, which is to be erected by Chris. Walters, of the Walters Brewing Co.

Milwaukee, Wis.—Geo. W. Chandler, it is reported, intends erecting a family hotel and apartment house on Oneida St. and Juneau Pl., and is having plans prepared by Hood & Tullgren, 82 Wisconsin St., for a 4-story brick and stone structure, the cost to be about $100,000.

Mexico City Mex.—The Knights Templar, it is stated, are contemplating the erection of a building in this city to cost about $100000.

NEW YORK, N. Y.

67 Canon St., 2 6-story br. and stone stores and tenemts. total c, $70,000; o, Hillman & Price a, Saml. Sass.

51 Sheriff St., 3-story br. and stone stable and loft bldg.; c, $30,000; o, Solomon Feiner; a, Horenburger & Straub.

364 E. 10th St., 6-story br. and stone store and tenemt.; c, $45,000; o, Louis Kotzen; a, Saml. Sass.

114 W. 17th St., 6-story br. and stone store and loft bldg.; c, $125,000; o, Domestic Realty Co.; a, Schickel & Ditmars.

34 W. 32d St., 12-story br. and stone warehouse; c, $100,000; o, W. A. Schiffer; a, Chas. Volz.

25 W. 39th St., 15-story br. and stone engineering society bldg.; c, $975,000; o, The Engineering Society; a, Herbert D. Hale.

55th St. and 12th Ave., 5-story br. and stone lumber mill; c, $30,000; o, Thos. G. Patterson; a, Morgan & Slattery.

Bway. and 55th St., 4-story br. and stone store and loft bldg.; c, $35,000; o, Arthur R. Ward; a, Townsend, Steinle & Haskell.

384 5th Ave., 8-story br. and stone store and storage bldg., c. $70,000; o, Gorham Mfg. Co.; a, McKim, Mead & White.

214 E. 123d St., 6-story br. and stone stores and tenemts; c, $46,000; o, Abraham Perelman; a, Geo. F. Pelham.

236 W. 116th St., 2-story br. and stone store and loft bldg.; c, $30,000; o, Paul Mayer; a, V. Hugo Koehler.

171st St. and St. Nicholas Ave., 5-story br. and stone store and tenemt.; c, $30,000; o, Donald Robertson; a, Moore & Lansiedel.

Plans have been filed for enlarging the 6-story loft building at Bway and 20th St. into a 10-story store and office building, the cost to be $200,000. Robt. Goelet, owner; Maynicke & Franke, 298 5th Ave., are the archts.; also for remodeling the 4-story and basement loft building at 115 W. 42d St. into a bank and office building for the American Savings Bank, cost $20,000. Chas. E. Reid, 105 E. 14th St., archt. Plans have also been filed for a 10-story office building to be erected at Bway and Maiden Lane for the Title Guarantee & Trust Co., cost, $500,000. Howells & Stokes, 100 William St., are the archts.

CHURCHES AND DWELLINGS.

Notes Arranged Alphabetically by States.

**Santa Barbara, Cal.*—It is reported that the Mission City Bldg. & Contr. Co., of San Francisco, has secured the contract to erect a residence on Arlington Heights for Mrs. Hester, of New York, at about $47,000.

**New Haven, Conn.*—J. H. S. Ferguson has secured the contract for a stone dwelling for Saml. A. York for $21,000.

Denver, Colo.—The F. E. Edbrooke Archt. Co., 510 Opera House Blk., it is reported, is preparing plans for a 4-story apartment house which is to be erected at Clarkson St. and 18th Ave., at a cost of about $35,000 by Sherley Moore.

Contracts have been awarded to W. Healy for carpenter work and P. Velenti for mason work for a brick student apartment house to cost $35,000. Architect of both of the above buildings, Brown & Von Beren, Exchange Bldg.

Gainesville, Ga.—It is reported that the members of the First Methodist Church intend erecting a $30,000 edifice. Address Pastor.

Peru, Ill.—Bids are being received for a parochial residence for St. Joseph's Parish, to cost about $10,000. Henry F. Wachter, Archt., Peru.

Freeport, Ill.—The members of the Emberg Methodist Church, it is stated, are contemplating the erection of a $75,000 edifice. Address Pastor.

Chicago, Ill.—John C. Krietenstein, the builder, will improve the southeast corner of Galt Ave. and Hazel St. with a 3-story apartment, 100x118 ft., which is to cost $55,000.

Atchison & Co., 90 Washington St., have plans for a 3-story high-grade apartment, 100x75 ft., to be erected on Grace St., near Sheridan road, at a cost of $50,000.

J. Speyer & Son, 164 La Salle St., have prepared plans for a 3-story apartment building, 50x165 ft., to be built at 2089 Sheridan Road, at a cost of $48,000.

Waukegan, Ill.—It is reported that the members of the St. Mary's R. C. Church intend erecting an edifice to cost $50,000. No plans prepared as yet. Rev. F. W. Gavin, pastor.

Caryle, Ill.—The erection of a new edifice to replace the St. Mary's R. C. Church at a cost of $50,000 is reported under consideration.

Lincoln, Ill.—It is reported that arrangements are being made for the erection of a $20,000 church here. Rev. Wm. N. Wyckoff, Pastor.

Terre Haute, Ind.—The members of the Central Christian Church, it is reported, intend erecting an edifice to cost $60,000.

**Hoagland, Ind.*—It is reported that Mann & Christen, of Decatur, have received the contract to erect an edifice for the English Lutheran Church, the cost to be about $16,000.

New Harmony, Ind.—The Trus. of the Methodist Church, it is reported, have selected plans for the erection of a $20,000 edifice.

Des Moines, Ia.—It is stated that R. M. Mount will erect a 3-story flat at 17th and Pleasant Sts. at a cost of $30,000.

**Louisville, Ky.*—It is reported that the contract to erect the Jewish Synagogue has been secured by Bailey & Korner, of Henderson. The structure is to cost about $125,000.

McDonald & Scheblessey, of Louisville, are preparing plans for a 5-story addition which is to be erected to the Weissinger-Gaulbert Apartment House, at an estimated cost of $70,000.

**Baltimore, Md.*—The contract to erect a 3-story apartment house for Prof. W. H. Maltbie at Charles and 27th Sts., it is stated, has been awarded to B. T. Bennett, 123 S. Howard St. Probable cost, $20,000.

New Bedford, Mass.—The First Congregational (Unitarian) Society contemplates an expenditure of about $30,000 in remodelling its church, chapel and organ.

Worcester, Mass.—The members of the First Baptist Church, it is stated, are contemplating the erection of a new edifice to cost about $150,000.

**Lansing, Mich.*—Chittenden & Skinner, of Lansing, it is reported, have been awarded the contract to erect an apartment house at Kalamazoo and Grand Sts., at a cost of $15,500.

Detroit, Mich.—Joy & Barcroft, 408 Ferguson St., it is reported, have been engaged to prepare plans for a 10-story apartment house, which is to be erected at Park and Elizabeth Sts. by Turfts & Strong.

The members of the Hudson Ave. M. E. Church it is stated, intend erecting a new edifice at Grand River and McGraw Aves., the cost to be about $45,000. H. J. Booth, Chmn. Bldg. Com.

Grand Rapids, Mich.—Geo. E. Ellis, it is reported, has purchased a site at Island and Lagrave Sts., and will erect a $40,000 apartment house.

Rochester, N. Y.—It is reported that an Italian R. C. Church is to be erected in this city and is to be known as the Church of Our Lady of Mt. Carmel. Probable cost, $25,000. Rev. Emil Gefeil, pastor.

Geneva, N. Y.—The congregation of the Methodist Church, it is reported, are preparing to erect a $40,000 edifice. Rev. C. E. Jewell, Pastor.

Horseheads, N. Y.—A new edifice is to be erected for the Methodist Church, according to plans prepared by Jas. W. Yard, of Erie, Pa., the cost to be about $16,000. Rev. W. H. Yard, pastor.

Tiffin, O.—W. R. Dowling, of Toledo, it is reported, is preparing plans for a $40,000 edifice which is to be erected for the St. Mary's R. C. Church. Rev. T. F. Conlan, pastor.

Bucyrus, O.—J. C. Fulton, of Uniontown, Pa., it is stated, has prepared plans for a new edifice for the Presbyterian church, which is to cost about $20,000.

Wauseon, O.—It is reported that the Trus. of the Christian Church have decided to erect an edifice at a cost of $21,000. No plans have been prepared as yet.

**Steubenville, O.*—Andrews Bros., Schofield Bldg., Cleveland, have secured the contract for erecting an edifice for St. Peters Church, for $81,500. Architect, Emile M. Unirich, 1328 Schofield Bldg.

**Sharpsburg, Pa.*—J. P. Ray, of West Newton, it is reported, has secured the contract to erect the Presbyterian Church, the cost to be about $35,000.

**Crafton, Pa.*—Chas. Reif, Jr., of Allegheny, it is stated, has received the contract to erect an edifice for the First Presbyterian Church, the cost to be about $30,000.

Philadelphia, Pa.—The members of the North Presbyterian Church, it is stated, are contemplating the erection of a stone edifice to cost about $50,000.

Pittsburg, Pa.—It is reported that Price & McLenahan, of Philadelphia, prepared plans for a 3-story residence which is to be erected on Amberson Ave., for J. J. Turner, 3d Vice-Pres. of the Pennsylvania R. R., the cost to be about $40,000.

*Henry Shenk Contr. Co., Lewis Blk., it is reported, has received the contract to erect a residence for R. G. Gillespie, at 5th and Aiken Aves., the cost to be about $43,000.

**Penllyn, Pa.*—J. S. Cornell, Land Title Bldg., Philadelphia, it is reported, has received the contract to erect a residence here for Francis E. Bond, the cost to be about $40,000.

Pittsburg, Pa.—Beezer Bros., 6200 Penn Av., it is reported, are the archts. for a residence which is to be erected on Squirrel Hill for W. L. Stewart, at a cost of $65,000.

**Items marked thus give the names of parties awarded contracts.*

Philadelphia, Pa.—A building permit has been granted to Doyle & Doak, 1509 Sansom St., to erect a 4-story residence at 22d and Locust Sts., at a cost of $25,000. Horace Trumbauer, Land Title Bldg., Archt.
*Marion Zane, it is stated, has received the contract to erect a residence for Judge Chas. Y. Audenried at 631 Lombard St., at a cost of $20,000.

Memphis, Tenn.—L. M. Weathers, Cotton Exchange Bldg., it is stated, has prepared plans for a 5-story flat which is to be erected at Vance and De Soto Sts., by Leopold, Harry and Benj. P. Horn at a cost of about $50,000.

Dallas, Tex.—Plans have been completed by H. A. Overbeck, Slaughter Bldg., for a 2-story brick flat which is to be erected at Akard and Young Sts., at a cost of $20,000.

Parkersburg, W. Va.—It is stated that F. S. & H. O. Smith are having plans prepared for an apartment house which is to cost $18,000.

New York, N. Y.—Broadway and 99th St., 9-story br. and stone tenemt; c, $150,000; o, Thos. Healy; a, Horgan & Slattery.
120 th St. and 7th Ave., two 6-story br. and stone tenemts; total c, $70,000; o, Geiger & Braverman; a, Neville & Bagge.
127th St. and Madison Ave., 6-story br. and stone tenemt; c, $40,000; o, Levy & Steinmann; a, Glasser & Ebert.
146th St. and B'way, 5-story br. and stone tenmt; e, $50,000; o, O. C. Moore & Bros.; a, Moore & Landsiedel.
173d St. and St. Nicholas Ave., two 5-story br. and stone tenemts; total c, $70,000; o, Economy Bldg. & Realty Co.; a, John Hauser.
Faile and Aldus Sts., 3-story br. dwells.; total, c, $160,000; o, American Real Estate Co.; a, Wm. D. Johnson.
148th St. and St. Anns Ave., six 5-story br. tenemts; total c, $180,000; o, Louis Grimm; a, B. Ebeling.
156th St. and Forest Ave., four 6-story br. tenemts; total c, $150,000; o, Katz & Polacek; a, John Hauser.
156th and Fox Sts., four 5-story br. tenemts; total c, $150,000; o, Bronx Borough Realty Constr. Co; a, Jas. F. Meehan.
Beekman Ave. and 141st St., two 5-story br. tenemts; total c, $60,000; o, Louis Arndstein; a, M. J. Garvin..
Brook Ave. and 169th St., four 5-story br. tenemts; total c, $175,000; o, Albert J. Schwarzler; a, M. J. Garvin.
3d and Wendover Aves., three 5-story br. tenemts; total c, $125,000; o, Saml. Borowsky; a, Geo. F. Pelham.
104th St. and 3d Ave., 6-story br. and stone tenemt; c, $50,000; o, Nathan Silversen; a, Bernstein & Bernstein.
118th St. and 3d Ave., two 6-story br. and stone tenemts; total c, $100,000; o, David Amolsky; a, Bernstein & Bernstein.

SCHOOLS.

Notes Arranged Alphabetically by States.

**Anniston, Ala.*—J. H. Drake, of Anniston, it is reported, has received the contract to erect a building for the Synodical College, the cost to be about $75,000.

Long Beach, Cal.—It is stated that plans are about completed for a 16-room school which it is proposed erecting at 6th and Pine Sts., $75,000 bonds having been issued for the purpose.

San Francisco, Cal.—The Bd. of Super. has authorized the construction and equipment of alterations and additions to the Crocker Grammar School at an estimated cost of $17,500.

Riverside, Cal.—Bids will be received until June 8 by the Comr. Indian Affairs, Dept. of the Interior, Washington, D. C., for furnishing materials and constructing complete an irrigation system for the school farm and a brick stable, with plumbing and electric light; for further information address Harwood Hall, Supt., Riverside.

Oakland, Cal.—The following are reported to be the bids received for erecting the Franklin School: (*a*) entire work; (*b*) entire work except marble and tile work; (*c*) carpenter work: W. W. Anderson, *a* $52,997, *b* $44,642, *c* $27,717 Chas. Roeth, *a* $47,899; Cook & Young, *a* $54,980, *b* $47,480; Brucker & Lewis, *a* $52,287, *b* $44,322, *c* $25,518; Ramsden, Griffith Co., *c* 35,241; C. Christensen, *c* $34,311; H. E. Brown & Co., *c* $25,071; W. T. Veitch & Bros., *c* $27,329.

Pueblo, Colo.—The taxpayers of School Dist. No. 1, it is stated, have voted in favor of issuing $25,000 bonds to erect a new school in Irving Place. It is stated to be the intention of the School Bd. to have plans prepared for the building at once and to award the contract for construction as soon as possible.

Golden, Colo.—Simon Guggenheim, it is reported, has approved the plans for a 2-story building which is to be erected at the School of Mines at a cost of about $100,000.

**Wallace, Idaho.*—John Berne, of Missoula, Mont., it is reported, has received the contract to erect a school for the parish of Our Lady of Lourdes, the cost to be about $25,000.

**Peru, Ill.*—The contract to erect a parochial school with Sisters' quarters in connection, to cost $31,000 complete, has been awarded to Jos. Neufelt, of Peru. Henry F. Wachter, Archt.

Geneva, Ill.—It is reported that the School Bd. intends erecting a $15,000 addition to the High School.

East St. Louis, Ill.—Bids will be received June 5 by the Bd. of Educ. (J. J. Reader, Secy.) for erecting an addition to Lincoln School.

**Champaign, Ill.*—English Bros., it is reported, have received the contract to erect an addition to the high school at $13,698.

Elgin, Ill.—School bonds amounting to $45,000 have been sold.

Chicago, Ill.—Wm. J. Brinkman, 163 Randolph St., it is stated, is receiving bids for improvements to be made to the St. Mary's Training School for Boys at Feehansville, Ill. Rev. Geo. Thomas McCarthy, Pres. It is reported that a number of 1 and 3-story buildings are to be erected, including 2 dormitories, a machine shop, 2 convents, a laundry and machine shop. It is estimated that the cost of the improvements will be about $400,000.
A 3-story stone and pressed brick parochial school is to be erected for the parish of St. Stanislaus at a cost of $120,000.

Galena, Ill.—It is reported that bids will be received until June 6 by the Bldg. Com., School Bd., (Wm. Rippin, Clk.,) for erecting a high school.

**Muncie, Ind.*—Fred. Illingworth & Co., of Muncie, it is reported, have received the contract to erect the McKinley School at about $31,000.

St. Wendells, Ind.—It is reported that bids will be received until June 10 by the School Bd. (Jas. M. Haines, Trus.) for erecting 2 brick schools in Robinson Township.

**Cresco, Ia.*—The following are reported to be the bids opened by the School Bd. on May 5 for erecting the high school. The bids include certain deductions: F. X. White, Eldora, Ia., $26,786; Gus Johnson, of Garner, Ia., $27,130; J. B. Nelson & Co., of Mankato, Minn., $23,469; H. A. Paine, Albert Lea, Minn., $24,959; C. F. Reimer, of Marshalltown, Ia., $23,562; W. H. Jackson, White Bear, Minn., $25,224; W. T. Fuelling, Minneapolis, Minn., $22,842; Martin Johnson, Cresco, $22,201; Crittenden & Wentworth, Cresco, $21,782 (awarded contract).

Holton, Kan.—Bids will be received by the Bd. Educ. until June 1 for erecting a high school.

Baton Rouge, La.—Bids will be received until June 12 by W. H. Bynum, Mayor, for erecting a 2-story and basement brick school; Favrot & Livaudais, Ltd., Archts., 839 Graven St., New Orleans; L. J. Granary, City Aud.

Baton Rouge, La.—See "Water."

Beverly, Mass.—The plans of Cooper & Bailey, 95 Milk St., Boston, have been accepted by the Bldg. Com. (Jeremiah E. Desmond, Chmn.) for the school which it is proposed erecting at Balch and McKay Sts. The plans provide for a 3-story and basement brick and stone structure containing 16 rooms and an assembly room, and the cost is to be about $65,000.

Wellesley, Mass.—Andrew Carnegie has given $125,000 to Wellesley College to erect a library provided a like sum is raised.

Malden, Mass.—The Com. appointed to obtain plans for an 8-room brick school to be erected in the Maplewood Dist. has selected the plans of Edw. L. Wilson, of Boston. The cost of the building is to be about $40,000.

Manchester, Mass.—At the town meeting May 23, it is stated, it was voted to erect a 4-room school at a cost of $30,000. Andrews, Jacques & Rantoul, State Mutual Bldg., Boston, are to be the archts. for the building.

Cambridge, Mass.—Andrew Carnegie, it is stated, has given to Radcliffe College $75,000 to erect a library, provided a similar sum is raised.

Ashburnham, Mass.—Cooper & Bailey, 95 Milk St., Boston, it is stated, have prepared plans for a school which is to be erected here at a cost of $20,600, and is to be known as the Dolly Whitney Adams School.

Haverhill, Mass.—The plans of C. Willis Damon, 25 Washington St., it is stated, have been accepted for the brick school which is to be erected in Ward 5, the cost to be about $17,210.

Amherst, Mass.—It is reported that bids are soon to be asked for erecting a horticultural building at the Massachusetts Agricultural College, the cost, including equipment, to be about $39,950.

Maynard, Mass.—The citizens have voted in favor of borrowing $18,000 for the erection of an 8-room school and the purchase of a site for the same.

Ann Arbor, Mich.—Malcomson & Higginbotham, of Detroit, it is reported, have prepared plans for a $100,000 high school, and it is stated, bids will be asked for the construction of same at once.

Detroit, Mich.—A bill has been signed by the Governor authorizing Springwells Township to issue $50,000 bonds to refund the present bonded indebtedness and erect a new school.

Bay City, Mich.—The Bd. of Educ. is reported to be considering the issuing of $50,000 bonds for school improvements.

Duluth, Minn.—The following are reported to be the bids received for erecting the Manual Training School: Theodore Nauffts, $40,500; George H. Lounsberry, $42,555; L. H. Campbell & Co., $40,579; McLeod & Smith, $38,900; J. R. Quigley, $39,477; J. S. Schleunes, $43,316; Watterworth & Fee, $42,980; Smith & Oakes, $44,395; John Grandy, $41,263; J. O. Roberts, $39,749; H. Fawcett, $38,000; D. E. & Constr. Co., $38,850.

Minneapolis, Minn.—The Bd. of Regents and the State Bd. of Control, it is stated, have selected a site on University Ave., between 15th and 16th Aves., on which it is proposed erecting the main building, an appropriation of $406,000 being available for the purpose.

**Chinook, Mont.*—Saml. Houston, of Chinook, it is reported, has received the contract to erect the school, including heating plant, $23,669, or without heating plant, $21,269.

**Bozeman, Mont.*—F. W. Vreeland, of Bozeman, it is stated, has received the contract to erect an 8-room school at $17,350.
It is reported that bids will be received until June 1 by the Bd. School Trus. for plumbing and heating in several schools.

Orange, N. J.—Bids will be received until June 6 by the Bldg. Com., Bd. Educ. (Horace Stetson, Secy.) for furnishing materials and erecting a High School at Main and Cleveland Sts.; probable cost, $90,000. Herbert D. Hale, Archt., 92 William St., New York, N. Y.

Princeton, N. J.—A recitation building is to be erected at Princeton Univ., to be known as McCosh Hall, and is to cost about $200,000.

New York, N. Y.—Bids will be received until June 5 by C. B. J. Snyder, Supt. School Bldgs., for alterations and repairs to several schools in the Boro. Brooklyn; also on June 12 for alteration and repairs to various schools in the Boros. of Manhattan and Brooklyn.
*The following are the bids opened May 22 by C. B. J. Snyder, Supt. School Bldgs., for general construction of school No. 81, Manhattan Boro.: Richard E. Heningham, $310,714; Thos. B. Leahy Bldg. Co., $360,670; Geo. Hildebrand, $316,400; Patrick Sullivan, $328,000; Chas. H. Peckworth, $311,365; P. J. Walsh, $314,000; Thos. Cockerill & Son, $314,500 and P. J. Brennan, 63 W. 22d St., $309,400 (awarded contract).
Bids were opened same time and place for general construction, etc., of addition to and alterations in school 69, Boro. of Manhattan: Lincoln & Ranney, $71,940; Tolmie & Kerr, $73,687; Wm. Werner, $72,765; P. Gallagher, $79,307; Edmund D. Broderick, $87,000; Geo. Hildebrand, 1004 Bway., $69,940 (awarded contract); Thos. McKeon, $76,339; Chas. H. Peckworth, $77,170.

**Long Island City, L. I., N. Y.*—Wm. C. Ormond, 14 Herbert St., Brooklyn, has secured the contract for sanitary work of additions to and alterations in school No. 71 on Prospect Pl., Metropolitan Queens Boro. (bids opened May 22) for $6,980.

**Buffalo, N. Y.*—It is reported that contracts have been awarded as follows for erecting a school on Clinton St., in Dist. No. 7: Masonry, etc., Peter H. Frank, $10,400; carpentery, etc., Adolph F. Bournique, $6,125; roofing, etc., Machwirth Bros. Co., $1,444; heating, etc. John W. Danforth Co., $7,575, and plumbing, etc., Hurley & Stygall $2,746. Total, $28,290.
A bill has been signed by the Governor authorizing Buffalo to issue $300,000 bonds for school purposes.

Baldwinsville, N. Y.—The citizens have voted in favor of erecting an addition to the high school at a cost of $12,000.

Plymouth, O.—Press reports state that bids will be received until June 5 by the Bd. Educ. (Albert Kirkpatrick, Clk.) for erecting a school in Plymouth Township.

St. Johns, O.—Bids will be received until June 19 by the Bd. Educ. (Jacob Gnaigi, Clk.) for erecting a 4-room school, including cement work, brick work, stone work, structural iron metal work, carpentry, etc.; W. W. Runkle, Archt., Wapakoneta.

Piqua, O.—Bids will be received by the Bd. Educ. (Geo. Dettmer, Clk.) until June 10 for furnishing materials and erecting a 4-room addition to the South St. School; also for furnishing materials and remodeling and enlarging the Fountain Park Baptist Church for school purposes.

Buckland, O.—Bids will be received until June 5 by the Bd. Educ. (Jacob F. Brorein, Clk.) for installing a ventilating and heating apparatus complete in place for school to be erected here; W. W. Runkle, Archt., Wapakoneta.

Toledo, O.—Bids will be received June 5 by the Bd. Educ. of Oregon Township, Lucas Co. (Jas. D. Coy, Clk.) for furnishing materials and erecting a school in Oregon Township.
Bids will be received June 17 by the Bd. Educ. (G. Otto Haubold, Clk.) for furnishing materials and erecting an 8-room addition to the Hoag School; L. G. Welker, 950 Spitzger Bldg.
Press reports state that bids will be received until June 17 by the Bd. Educ., of Monclove Township (Don C. Whitehead, Clk.) for erecting a school in Monclova Township.

Youngstown, O.—School bonds amounting to $45,000 have been sold.
The Bd. of Educ., it is stated, is considering plans submitted for a 10-room school, which it is proposed erecting on Myrtle Ave.

Massillon, O.—It is stated that school bonds amounting to $27,000 have been sold.

Mt. Gilead, O.—C. A. Stribling, of Columbus, is said to be preparing plans for a school which is to be erected here at a cost of $15,000.

Cleveland, O.—Emile M. Uhlrich, 1328 Schofield Bldg., has completed plans for a school for the Church of Our Lady of Lourdes and bids for its construction will be received June 15.

**Klamath Falls, Ore.*—The Co. Comrs., it is reported, have awarded the contract to erect the brick high school to H. Snook, of Salem, Ore., and W. O. Heckert, of Eugene, Ore., the total cost to be about $29,500.

Carrick, Pa.—T. W. Boyd & Co., of Pittsburg, it is reported, have prepared plans for a school which is to be erected here at a cost of $30,000.

Sharpsburg, Pa.—Bids will be received May 31 at the office of Hall & Stevens, Archts., House Bldg., Pittsburg, for erecting a school at Clay and Linden Sts.

Wilkesbarre, Pa.—The following are reported to be the bids received for erecting a school on Courtright Ave.: George Eckert, $48,365; Matthias Stiff, $43,465; A. J. Burlingame, $46,075.

Carlisle, Pa.—Bids will be received by Capt. Wm. A. Mercer, Supt. Indian School, Carlisle, for furnishing and delivering building materials, including 44,500 ft. lumber; 2,000 lath; 12 window and door frames; 147 perch stone; 119,000 brick; quarrying stone; laying brick; carpentry, etc.

Providence, R. I.—The City Council has appropriated $150,000 for the enlarging and furnishing of the Technical High School.

Brookings, S. D.—Bell & Detweiler, of Minneapolis, Minn., it is reported, have completed plans for a school to be erected here at a cost of $15,000.

Ft. Workth, Tex.—Bids will be received until June 2 by John B. Hawley, City Engr., for 2 steam heating plants, to be installed in Van Zandt and De Zavalla schools, now in course of erection.

Port Arthur, Tex.—A. M. Rutan, Secy. School Trus., writes that bids will be received June 20 for the erection of a high and manual training school. Architects, F. C. Wagner & Co., 423 Temple Court Bldg., Denver, Colo.

Salt Lake City, Utah.—The Bd. of Ed. of the Granite School Dist. of Salt Lake County will erect a school in the suburbs of Salt Lake City, to cost about $18,000.
The Bd. of Regents of the Univ. of Utah, it is reported, has rejected all bids received for erecting (*a*) gymnasium, and (*b*) extension to Physical Bldg., as they were too high, the bids received being as follows: F. J. Armstrong, *a* $23,138, *b* $16,751; Oliver Hodgson, *a* $23,644, *b* (excepting heating) $10,890; J. H. Brittain, *a* $26,342, *b* $13,544, and Salt Lake Bldg. & Mfg. Co., *a* $27,024.

**Items marked thus give the names of parties awarded contracts.*

Spokane, Wash.—Julian & Williams have prepared plans for a school for the Church of Our Lady of Lourdes to cost $20,000.

Charleston, W. Va.—The Bd. of Regents of the State Normal School has submitted to the Bd. of Claims plans for a building to be erected at Marshall College, the cost to be about $40,000.

**Buckhannon, W. Va.*—The Trus. of the Wesleyan Univ., it is reported, have awarded the contract for erecting the new building at the Univ. to replace the structure which was recently destroyed by fire, to Elliott & Winchell, of Clarksburg, at $57,255. It is stated that this contract does not include the erection of a boiler house and the installation of a ventilating and heating apparatus, which will cost an additional $25,000.

Waukesha, Wis.—The Presbyterians of Wisconsin and Illinois, it is reported, have decided to increase the capital of Carroll College from $120,000 to $300,000 for the purpose of enlarging the college. A girls' dormitory is to be erected at a cost of $30,000.

Milwaukee, Wis.—Buemming & Dick, 1107 Pabst Bldg., have completed plans for the $135,000 North Division High School, which provides for a 2-story structure of pressed brick, with Bedford stone trimmings, composition roof, electric lighting and steam heat.

**Winnipeg, Man.*—Contracts, it is reported, have been awarded for erecting the King School on W. Ellice Ave., as follows ((bids received May 9): Masonry, Smith & Sharpe, $23,850; carpentering, S. B. Ritchie, $12,135; tin and galvanized, Douglas Bros., $2,697; plumbing, A. T. Kernaghan, $657; electric wiring, D. H. Hudson, $400; heating and ventilating, W. F. Rutley Co., $3,680.

Toronto, Ont.—Bids will be received until May 30 by the Bldg. Com. (John Vokes, Secy.) for erecting a Sunday school bldg. for Wesley Church, Dundas St. and Ossington Ave.; W. G. Burns, Archt., 361 Dundas St., Toronto.

STREET CLEANING AND GARBAGE DISPOSAL.

Notes Arranged Alphabetically by States.

New York, N. Y.—Bids will be received until June 5 by J. McG. Woodbury, Comr. of Street Cleaning, for furnishing materials required to construct and install a conveyor for the rubbish incinerator at Delancey Slip, Boro. Manhattan.

NEW INDUSTRIAL PLANTS.

Notes Arranged Alphabetically by States.

The Blades Lumber Co., Newbern, N. C., will at once rebuild its dry kilns, which were recently burned. It is planned to build five kilns, 20 ft. wide by 130 ft. long, of about 100,000 ft. daily capacity.

The Nashville, Tenn., Warehouse & Elevator Co. has let contract to the Macdonald Engineering Co., of Chicago, for a 250,000-bu. annex of reinforced concrete to its present elevator. The annex will be operated from the company's present power plant and about 100 h.p. additional boiler capacity will be required.

The Paragon Phosphate Co., 18 Cole Bldg., Nashville, Tenn., will build a plant consisting of a crusher, drier, mill and screens, to have a capacity of 8 tons per hour. A 100-h.p. engine and a 125-h.p. boiler will be installed.

The Kaysville, Utah, Milling Co. has let contract for machinery for a 100-bbl. flour mill and will build an elevator of 30,000 bu. capacity. The company is investigating the advisability of using steel tanks. Peter Barton, pres.

The Davenport, Ia., Foundry & Machine Co., contemplates the erection of a 187x100-ft. foundry, to be equipped with an electric traveling crane, core rooms and rattling rooms.

The National Wheel Co., Perrysburg, O., will erect a 3-story, 125x150-ft. addition to its plant.

The Andersen & Winter Mfg. Co., Clinton, Ia., expects to erect this summer a 3-story and basement brick building of mill construction, 105 ft. square, to be used as a furniture factory. The equipment will include a 150-h.p. boiler and Corliss engine, elevators, etc.

The A. Priesmeyer Shoe Co., Jefferson City, Mo., is having plans prepared for a 5-story, 180x45-ft. factory. Details regarding the power plant have not been decided, but it is expected to install a 100-h.p. Corliss engine.

The New Orleans Pure Milk Co., Tulane-Newcomb Bldg., New Orleans, La., contemplates the erection of a sanitary milk plant, to be about 100x200 ft. The boilers and engines will be of about 100 h.p. capacity.

W. J. West, West's Mills, N. C., is planning to erect a 30-bbl. flour mill, to be run by water power.

The Carter County Fire Brick Co., Saulsberry, Ky., will erect a factory, but the capacity has not yet been decided. John S. Haley, secy.

The Anderson, Ind., Canning Co. will erect a new plant. The company has 3,000 acres of corn under contract to be packed this fall and expects to use about 4,000,000 cans. The buildings will comprise about 65,000 sq. ft. floor space.

The New England Enameling Co., Middletown, Conn., is erecting a 2-story, 50x100-ft. additional brick building, to be used principally for galvanizing purposes.

H. B. Carter, Aiken, S. C., wants prices of roofing and pumps for ice plant. Contract for ice machine has been let.

J. M. Craig, Hartford, Conn., will remove his brass foundry to 69 and 71 Arch St., about July 1. He will probably install a 10-h.p. motor.

The Union Saw Mill Co., Huttig, Ark., expects to erect a 60x200-ft. saw mill in the near future and to install a power plant of about 1,000 h.p. capacity.

The Spencer Kellogg Co., Buffalo, N. Y., has bought a site in New Jersey, where it contemplates erecting a linseed oil mill.

J. W. Streetman, Marion, N. C., is investigating the establishment of an overall factory to have 20 or 25 machines and to be run by a gasoline engine.

The Carolina Light & Power Co., Aiken, S. C., will install a 15-ton compression ice plant with motor drive and 5,000 cu. ft. refrigeration. Bids are wanted on sinking a well 550 ft. 8 in. deep and deep well pump, with power head for motor drive. Harry Sudlow, mgr.

The Iron Clad Mfg. Co., 204-206 Varet St., Brooklyn, N. Y., has bought the plant of the Maryland Stamping Co. and opened a branch factory in Baltimore. A 200x300-ft. building is now being erected, but this covers only about half of the property purchased, all of which is to be covered with buildings in a short time. The company has also let a contract for a 200x100-ft. addition to its Brooklyn works. Buildings covering about 400x150 ft. were recently burned and will be rebuilt when the insurance has been adjusted.

The Clifford Stone & Cement Co., Griffin, Ga., is in the market for machinery for manufacturing cement, brick and concrete building blocks, etc. The company expects to turn out 30,000 to 40,000 brick and 1,000 to 3,000 blocks every 10 hours. W. P. Laramore, gen mgr.

P. W. Minor & Son, Batavia, N. Y., will erect a 3-story, 170x40-ft. shoe factory. The capacity of the power plant will be about 30 h.p.

A bill has been signed by the Governor, making a special appropriation of $18,500 for rebuilding factory buildings at the Jackson (Mich.) prison recently destroyed by fire, according to newspaper reports.

Contract has been let by the Giesecke-D'Oench-Hays Shoe Co., Jefferson City, Mo., to H. J. Wallau for a 5-story, 250x50-ft. factory building, to cost about $60,000, according to local newspaper reports.

The Dold Packing Co., Buffalo, N. Y., has let contract to S. H. Woodruff for a 4-story, 120x180-ft. ad tion of concrete, to cost about $60,000, according to local newspaper reports.

The Waters-Pierce Oil Co., Houston, Tex., has applied for a permit to erect a plant to cover 3½ acres and to include six brick buildings and large storage tanks, at an estimated cost of $51,000, according to local newspaper reports.

The L. B. Harrison Estate, Cincinnati, O., has filed plans for a 12-story concrete and steel power building for light manufacturing at Fourth & Elm Sts., to cost $300,000, according to local newspaper reports.

O. C. Uehling, Milwaukee, Wis., is preparing plans for a foundry and machine shop, to cost $25,000, to be built at Grand Rapids for the Grand Rapids Foundry Co., according to local newspaper reports. Electricity, generated by water poyer, will be used for power and two electric cranes will be installed, it is stated.

The Booth Column Co., Toledo, O., is having plans prepared for doubling the capacity of its plant, according to local newspaper reports. The main building of the present factory is 134x50 ft., and there are several small wings, it is stated.

Huehl & Schmid are the architects for an industrial building to be erected for Walter C. Hately on Ontario St., west of Kingsbury, Chicago, Ill., according to local newspaper reports. It is stated that the building will be 3 stories, 100x120 ft., and cost $50,000.

Henry L. Ottenheimer is preparing plans for a 4-story, 100x75-ft. factory building of mill construction to be built at 17th St. and Armour Ave., Chicago, for the Allie C. Shank Co., according to local newspaper reports.

Benjamin Moore & Co. will erect a 4-story, 39x108-ft. factory building, to cost $25,000, at Kinzie & Green Sts., Chicago, according to local newspaper reports. Wm. Strippleman, archt.

A permit has been given the Ward, Corbey Co. to erect a $120,000 bread and bakery product factory at 140 Albany St., Cambridge, Mass., according to local newspaper reports.

Wm. Steele & Sons have secured a permit to erect a 3 and 4 story, 69x521-ft. factory building on 22d St., from Lehigh Ave. to Somerset St., Philadelphia, for the Lehigh Mfg. Co., according to local newspaper reports. The cost is stated as $200,000.

A 5-story addition is to be built to the plant of the Quaker City Shirt Co., Corson St. and Stony Creek R. R., Norristown, Pa., according to local newspaper reports.

Edward C. Van Leyen and Edward A. Schilling, Detroit, Mich., have prepared plans for a 3-story fireproof factory building and office to be built for the Star Watch Co., of Elgin, Ill., at Ludington, Mich., according to local newspaper reports.

MISCELLANEOUS.

Notes Arranged Alphabetically by States.

Hopefield, Ark.—It is stated that bids will be received until June 21 by the St. Francis Levee Bd. (W. B. Miller, Pres.,) for constructing approximately 870,000 cu. yds. levee and canal work; H. N. Pharr, Engr., 168 Randolph Bldg., Memphis, Tenn.

Walnut Hill, Ark.—Bids will be received June 20 by R. S. Lee, Sec.-Treas. Long Prairie Levee Bd., Walnut Hill, for constructing a levee from Bunkham Springs to Louisiana State line; about 700,000 cu. yds.

New London, Conn.—Lieut. Col. Chas. F. Powell, Corps. Engrs., U. S. A, writes that the following are the bids opened on May 20 for dredging in Milford Harbor, 55,000 cu yds. (price given per cu. yd.):Edw. O. Berry, Rensselaer, N. Y., 17 cts.; John P. Randerson, Albany,, N. Y., 19.5 cts.; John & Joseph McSpirit, Jersey City, N. J., 13.8 cts. (recommended for acceptance.)

Wilmington, Del—Bids will be received by Capt. C. A. F. Flagler, Corps Engrs. U. S. A., June 19, for dredging in Tuckerton Creek, N. J.; also on June 20 for dredging in Raccoon Creek, N. J., both advertised in The Engineering Record.

Bids will be received until June 21 by Capt. C. A. F. Flagler, Corps. Engrs., U. S. A., Wilmington, Del., for dredging in Alloway Creek, N. J.

Washington, D. C.—A. W. Greely, Chief Signal Officer, U. S. A., writes that bids will be called for about June 1 for furnishing the Signal Corps of the Army with telephone apparatus, to cost about $75,000. Models of practically all of this equipment may be seen in the Signal Corps Model Room, Washington, and drawings and specifications are under preparation. Bidders should call on Maj. Edward Russel, Lemon Bldg., for permission to inspect models.

Bids will be received until June 20 at the Treas. Dept., Bureau of Engraving and Printing (Wm. E. Meredith, Dir.) for an electric elevator.

Washington, D. C.—See "Power Plants, Gas and Electricity.

Chicago, Ill.—The South Park Bd. is stated to have sold bonds amounting to $1,500,000 for enlarging and improving the park system.

Rock Island, Ill.—Bids will be received June 19 by Lieut.Col. S. E. Blunt, Comdg., Rock Island Arsenal, for furnishing steel, iron and materials for heating and lighting.

**Havana, Ill.*—M. B. Dunbar, Drainage Comr., Green Valley, Ill., writes that R. H. McWilliams, of Mattoon, has secured the contract for cleaning out ditches 156,817 cu. yds. at 15½ cts., and Jas. Lewis, of Atwood, for cleaning out ditches 34,085 cu. yds. at 24 cts., 31,485 cu. yds. at 27 cts., and 22,933 cu. yds. at 26 cts. (bids opened May 19).

**Auburn, Ind.*—J. W. Pearl, of Benton Harbor, Mich., is stated to have secured the contract for the construction of Cedar Creek Drain No. 793 (bids opened May 11) at 6¼ cts. per cu. yd., or a total of $29,814. It will be about 21 miles in length and will require excav. of about 477,025 cu. yds.

Iowa City, Ia.—Bids will be received by the Bd. of Regents of the State Univ., on June 13, for the construction of a concrete dam across Iowa River, as advertised in The Engineering Record.

Baltimore, Md.—Bids will be received by Lieut. Col. R. L. Hoxie, Corps Engrs., U. S. A., Baltimore, June 20, for dredging in Patapsco River and Chesapeake Bay, Md., as advertised in The Engineering Record.

Baltimore, Md.—Bids will be received by Lieut. Col. R. L. Hoxie, Corps Engrs., U. S. A., June 21, for dredging in Susquehanna River, Md., as advertised in The Engineering Record.

The date of opening of bids by the Bd of Awards (E. Clay Timanus) for the construction of a stone and timber bulkhead to inclose and form Pier No. 4, has been postponed, owing to some difficulties in the way of transfer of State property. N. H. Hutton, Harbor Engr.

Boston, Mass.—The Senate on May 16 is stated to have killed the bill to incorporate the Massachusetts Ship Canal Co., with authority to construct a canal across Cape Cod by the so-called Bass River route.

Bids will be received by W. S. Stanton, Corps Engrs., U. S. A., Boston, June 26, for dredging in Salem Harbor; also same date for dredging in Weymouth and Town Rivers, Mass., both advertised in The Engineering Record.

Holyoke, Mass.—Bids will be received by the Bd. of Park Comrs., June 12, for the construction of a concrete masonry terrace wall, as advertised in The Engineering Record.

Detroit, Mich.—Bids will be received by Lieut. Col. Chas. E. L. B. Davis, Corps Engrs., U. S. A., June 22, for hire of a dredging plant and a steam derrick boat for use in St. Marys River, Mich.; also on June 20 for dredging in St. Mary's River at Bayfield Shoal and Entrance Angle to Middle Neebish, both advertised in The Engineering Record.

St. Paul, Minn.—City Engr. L. W. Rundlett estimates the cost at $6,000 to construct a tunnel under Whitall St. to carry a spur railroad track.

Paterson, N. J.—Governor Stokes has signed the bill, which authorizes a $200,000 bond issue by the city of Paterson for dredging channel of Passaic River below Passaic Falls.

New York, N. Y.—Bids wil be received until June 2 by the Dept. Docks and Ferries, (Maurice Featherson, Comr.), for furnishing and delivering about 10,000 bbls. Portland cement in Boro. Manhattan.

Bids will be received until June 1 by the Park Bd. (John J. Pallas, Pres.), for constructing entrances to Bronx Park, from Mosholu Parkway, and from Woodlawn Road, including masonry, fill, railing, steps, etc., in the City of New York.

The following are the bids opened on May 20 by the Superv. Archt., Treas. Dept., Washington, D. C., for elevator equipment for U. S. Custom House at New York: (*a*) Hydraulic, (*b*) electric (bidders all of N. Y. City): Otis Eleverator Co., *a* $165,440, *b* $94,850; Standard Plunger Co., *a* $152,500 and Marine Eng. & Machine Co., *b* $98,250.

*The following are the bids opened May 22 by the Dept. Docks & Ferries for building a pier near foot of W. 18th St.: Bernard Rolf, 39 Cortlandt St., $244,313; Wm. H. Jenks, 129 Pearl St., $242,750; G. B. Spearin, 17 Battery Pl., $233,210 (awarded contract); Geo. W. Rogers, 44 Bway., $257,884 and R. P. & J. H. Staats, 29 Bway., $245,191.

*Bids were opened same time and place for (*a*) 3 pile drivers, (*b*) 4 boat landing stages, (*c*) 4 driving scows, (*d*) 1 derrick: Danl. P. Leary, 476 Hudson St., *a* $37,490, *b* $5,740 (awarded contract), *c* $6,690; Alex. Miller & Bro., *a* $35,500, *b* $6,400, *c* $5,450, *d* $31,000; John F. Walsh, Jr., 60 Morton St., *a* $37,000, *b* $6,410, *c* $5,423 (awarded contract), *d* $31,600; J. Ed. Ogden Co., 147 Cedar St., *a* $34,300 (awarded contract), *b* $6,900, *c* $5,500, *d* $29,600 (awarded contract); Jas. Tregarthen & Son, *a* $36,050, *b* $6,300, *c* $5,490, *d* $31,000.

Buffalo, N. Y.—The following are the bids opened on May 13 by Lieut. Col. H. M. Adams, Corps Engrs., U. S. A., for the concrete superstructure on South Pier, at Buffalo: Lake Erie Dredging Co., Buffalo, $16,604; Grattan Contr. Co., Buffalo, $11,247; Continental Engr. & Contr. Co., $16,052; Louis Marbury, $12,413, and L. P. & J. A. Smith Co., Cleveland, O., $17,131. The detail bid of the Grattan Contr. Co, of Buffalo, the lowest bidder, is as follows: New hemlock timber above 4 ft. below mean lake level, 12 M. ft., $58.80; new hemlock timber 4 ft. below mean lake level, 1 M. ft., $1.20; Norway pine piles, ea. $18; 100 cu. yds. new stone fill., $1.25; 2,800 lbs. tie rods and anchor pins, 5 cts.; 50 cu. yds. masonry wall, $3.54; 196 cu. yds. concrete blocks, $8.80; 825 cu. yds. concrete in place, $7.40; and 2 manhole covers, ea. $3.60.

Lieut. Col. C. E. L. B. Davis, U. S. Engr., is reported to have been allotted $5,000 with which to make surveys of the waters in his district for the proposed new deep-water channel from Buffalo to Duluth. There will be an estimate of the cost of both a 22 and 25 ft. channel prepared, one of which will eventually be dredged.

The State Legislature is reported to have passed a bill providing for an appropriation of $50,000 for the improvement of Erie Basin.

The Governor has signed the bill authorizing this city to issue $150,000 bonds for the abatement of the old Main and Hamburg canal nuisance.

**Items marked thus give the names of parties awarded contracts.*

Cleveland, O.—The following are the bids opened on May 6 by Lieut. Col. Dan C. Kingman, Corps Engrs., U. S. A., for repairing shore end of West Breakwater at Cleveland Harbor: (*a*) Buffalo Dredging Co., Buffalo, N. Y.; (*b*) L. P. & J. A. Smith Co., Cleveland; (*c*) Hunkin Bros., Constr. Co., Cleveland; (*d*) Edw. M. Graves, Indianapolis, Ind.

	a	*b*	*c*	*d*
700 lin. ft. preparing old superstructure for new work	$7.00	$5.00	$18.00	$9.65
1,260 cu. yds. concrete blocks	15.00	12.00	10.00	14.50
5,150 cu. yds. concrete in mass	9.98	9.00	7.50	10.50
7,000 tons large riprap stone	1.60	1.45	1.25	1.45
50 M. ft. hardwood sheathing	1.55	160.00	135.00	150.00
14 M. ft. oak timber above water	75.00	50.00	60.00	100.00
6 M. ft. oak below water	125.00	100.00	100.00	200.00
800 lbs. mooring rings	.05	.06	.10	.20
16,000 lbs. lag screws and washers	.05	.04	.03	.06
3,500 lbs. screw bolts and washers	.05	.04	.03	.06
7,500 lbs. sleeve bolts and washers	.05	.05	.03	.06
6,000 lbs. tie rods and washers	.05	.04	.10	.25
Total	$89,964	$85,863	$82,255	$102,630

Tompkinsville, S. I., N. Y.—Bids will be received by Lieut. Col. W. T. Rossell, Corps. Engrs. U. S. A., June 21 for furnishing miscellaneous articles for the Light-House establishment for the fiscal year ending June 30, 1906, as advertised in The Engineering Record.

Governors Island, N. Y. H., N. Y.—Bids will be received by Lieut. Col. W. L. Marshall, Corps Engrs., U. S. A., Army Bldg., N. Y. City, June 22, for building stone sea wall at Governors Island, as advertised in The Engineering Record.

Yonkers, N. Y.—The Governor has signed the bill authorizing this city to expend $140,000 on docks and piers.

Cleveland, O.—The following are the bids opened May 11 by the Bd. of Pub. Service for constructing retaining walls in Brookside Park: Reaugh Constr. Co., $25,164; J. W. Norton, $23,453; W. J. Towsend Co., $27,642; N. O. Paving & Constr. Co., $28,098; Beers & Doolittle, $27,110; Williams Bros. & Morse, $25,863; Clement Bros. Constr. Co., $27,850; Jas. Duff & Co., $27,057; M. P. Platter, $29,109, and Alex. Tubman, $25,639. The detail bid of J. W. Norton, the lowest bidder, is as follows: 7,000 cu. yds. excav., 60 cts.; 1,350 cu. yds. concrete, $5.75; 660 cu. yds. masonry wall, style A, $7; style B, $6.25; 3,000 lin. ft. 4-in. pipe drain, 15 cts.; 2,000 lin. ft. 6-in. pipe drain, 18 cts.; 3,500 cu. yds. loam furnished, $1.25, and 560 cu. yds. old riprap stone broken up, $2.

Bids will be received May 31 by the Bd. Pub. Service (A. R. Callow, Secy.) for dredging and improving a portion of the Cuyahoga River; approximate quantity of material to be disposed of is 800,000 cu. yds.

Cleveland, O.—Bids will be received until June 19 by Lieut. Col. Dan. C. Kingman, Corps Engrs., U. S. A., 262 Huron St., for constructing the shoreward end of West Breakwater at Ashtabula Harbor

The following are the bids opened May 6 by Lieut.-Col. Dan C. Kingman, Corps Engrs., U. S. A., for filling with large riprap along lake face of West Breakwater, Cleveland Harbor: (*a*) Price per ton, 35,000 tons, (*b*) total: W. J. Gawne, Cleveland, O., *a* $1.39, *b* $48,650; Edw. M. Graves, Indianapolis, Ind., *a* $1.29, *b* $45,150; the L. P. & J. A. Smith Co., Cleveland, *a* $1.45, *b* $50,750; Buffalo Dredging Co., Buffalo, N. Y., *a* $1.50, *b* $52,500; the Federal Contr. Co., New York, N. Y., *a* $1.48, *b* $51,800.

Bids were opened same time and place for constructing shore end of West Breakwater at Fairport Harbor: (*a*) 160 squares fascines mattress, (*b*) 28,500 tons large place stone, (*c*) 12,000 tons quarry run stone, (*d*) $22,500 tons small rip rap stone, (*e*) total: The L. P. & J. A. Smith Co., Cleveland, *a* $28, *b* $3.25, *c* $2, *d* $1.87, *e* $163,320; the Federal Constr. Co., New York, N. Y., *a* $30, *b* $3, *c* $1.95, *d* $1.80, e $154,350; Buffalo Dredging Co., Buflo, N. Y., *a* $35, *b* $3.50, *c* $2.15, *d* $2, *e* $176,325.

Oklahoma City, Okla. Ter.—The Producers' Pipe Line & Refinery Co. is reported incorporated with a capital of $20,000,000, and headquarters in Oklahoma City, to build a pipe line from the Kansas fields southward through Okla., Ind. Ter. and Tex. to Galveston, to carry oil for export. Branch pipe lines will be constructed in all near-by fields that have refineries. K. Wright, of Davenport, Okla. Ter., is reported to be the chief promoter.

Panama.—See "Railroads."

Waynesboro, Pa.—Bids will be received until June 1 by the Town Council (Saml. C. Plank, Secy.) for $20,000 municipal bonds, to be used for improvements.

Pittsburg, Pa.—The Secretary of War, on recommendation of Gen. Mackenzie, Ch. of Engrs., is reported to have appointed a board of U. S. Engr. officers, consisting of Lieut. Col. D. W. Lockwood, of Washington, D. C.; Lieut. Col. E. H. Ruffner, of Cincinnati, O.; Lieut. Col. C. B. Sears, of New Orleans, La.; Maj. Geo. A. Zinn, of Wheeling, W. Va., and Maj. Wm. L. Sibert, of Pittsburg, to consider the question of general improvement of navigation of Ohio River from Pittsburg to its mouth.

Providence, R. I.—The lowest bid opened on May 15 by Lieut. Col. H. Willard, Corps Engrs., U. S. A., Newport, for dredging Providence River and Harbor, was submitted by the Columbia Dredging Co, 64 Broad St., N. Y. City, N. Y., at 8.45 cts. per cu. yd. Through error last week the Morris & Cummings Dredging Co were reported to be the lowest bidder. Its bid for this work was 10.5 cts. per cu. yd.

Belle Fourche, S. D.—Bids will be received at the office of the Engineer, U. S. Reclamation Service, Belle Fourche, on June 26, for the construction of a telepehone system about 16 miles in length, and having 4 telephone stations, in connection with the Belle Fourche project, as advertised in The Engineering Record.

Sabine Pass, Tex.—Bids will be received by Capt. J. F. McIndoe, Corps Engrs., U. S. A., New Orleans, La., June 15, for jetty work at Sabine Pass, Tex., as advertised in The Engineering Record.

Norfolk, Va.—Bids will be received by Capt. E. E. Winslow, Corps Engrs. U. S. A., Norfolk, June 19, for dredging Perqurmans River, N. C., as advertised in The Engineering Record.

Newport News, Va.—Bids will be received by the Superv. Archt. Treas. Dept., Washington, D. C., June 9, for the installation of pumping machinery for hydraulic lift in U. S. Post Office and Custom House, as advertised in The Engineeering Record.

Milwaukee, Wis.—Maj. J. G. Warren, Corps Engrs., U. S. A., writes that the following are the bids opened May 16:

Improving harbor at Milwaukee by the construction of a concrete superstructure in breakwater and on North Harbor Pier: Powell & Mitchell, Marquette, Mich., $129,698; Bennett & Schnorbach, Muskegon, Mich., $137,689; John E. Hathaway, Milwaukee, $131,150; Rudolph S. Blome Co., Chicago, Ill., $132,082; Ed. Gillen, Racine, $129,336; Adolph F. Bues, Milwaukee, $118,685; Great Lakes Dredge & Dock Co., Chicago, Ill., $129,838, and Wm. H. Gillen, Milwaukee, $11,696.

Improving Gladstone Harbor by dredging about 85,000 cu. yds: (*a*) price per cu yd., (*b*) total: Sam'l O. Dixon, Milwaukee, *a* 13½ cts., *b* $11,475; Great Lakes Dredge & Dock Co., Chicago, Ill., *a* 16½ cts., *b* $14,025; Greiling Bros., Green Bay, Wis., *a* 13¼ cts.; *b* $11,262; Joseph Wolter, Sturgeon Bay, Wis., *a* 13 cts., *b* $11,050.

Improving harbor at Waukegan, Ill., by removing old piers and building pile piers and timber superstructure: Bennett & Schnorbach, Muskegon, Mich., $89,476 using white pine, $86,859 using Douglas or Oregon fir, Southern or Norway pine; Edward Gillen, Racine, $71,111 using Douglas or Oregon fir timber; Great Lakes Dredge & Dock Co., Chicago, Ill., $69,634 using white pine, $68,401 using Douglas or Oregon fir or Southern or Norway pine timber.

*Stevens Point, Wis.—D. H. Pratt, of Plainfield, Secy. Portage County Drainage Dist., writes that Koch & Corbett, of Milwaukee, have secured the contract for constructing ditches in Portage County (bids opened May 10), at 7.5 cts. per cu. yd.; about 1,310,370 cu. yds. of earth. It is not expected to encounter any rock or hardpan, the soil is peat and muck with sand, clay and gravel subsoil.

New Carlisle, Que.—It is stated that bids will be received until June 9 by the Dept. of Pub. Wks. at Ottawa, Ont., (Fred. Gelinas, Secy.) for extending a wharf at this place.

PROPOSALS OPEN

For Proposals see pages 56, 57, 58a, 58b, 60, 61, 62, and 63.

WATER WORKS.

May 30. Pipe, Newmarket, N. H. ....May 20
May 31. Reservoir, New York, N. Y..........May 13
May 31. System, Shiprock, N. M............May 13
May 31. Boilers, Chicago, Ill. ....May 20
Jun. 1, Canal, etc., Glendive, Mont. ....Apr. 8
Adv. Ap. 8 to May 20.
Jun. 1. Main, Preston, Minn. ....May 20
Jun. 2. Engines, etc., Cincinnati, O. ....May 6
Jun. 2. System, Tulalip, Wash. ....May 13
Jun. 2. Gravity system, Bristol, Vt. ....May 20
Adv. May 20, 27.
Jun. 2. Mains, Harmony, Minn. ....May 27
Jun. 5. Irrig. work, Yuma, Ariz. ....May 6
Adv. May 6 to 27.
Jun. 5. Reservoir, etc., Crestline, O. ....May 20
Adv. May 20.
Jun. 5. Mains, Lakewood, O. ....May 20
Jun. 5. Water Wks., Belding, Mich. ....May 20
Jun. 5. Pipe, Montgomery, Ala. ....May 20
Jun. 5. Air compressors, etc., Montgomery, Ala.May 20
Jun. 5. Pipe, meters, etc., Winnipeg, Man. ..May 27
Adv. May 27.
Jun. 5. Water Wks., Nashwauk, Minn........May 27
Jun. 5. Pump engine, Wilmington, Del. ......May 27
Adv May 27.
Jun. 5. Inlets, Atlantic City, N. J. ....May 27
Adv. May 27.
Jun. 5. Well, St. Paul, Minn. ....May 27
Jun. 6. Tunnel, etc., Toronto, Ont. ....May 6
Adv. May 6 to 20.
Jun. 6. System, Northfield, Vt. ....May 20
Adv. May 20.
Jun. 6. Dams, Southbridge, Mass. ....May 27
Jun. 7. Supplies, Brooklyn, N. Y. ....May 27
Jun. 7. System, Vineland, N. J. ....May 27
Adv. May 27.
Jun. 8. Franchise, Ventura, Cal. ....May 6
Jun. 8. Irrig. system, Riverside, Cal. ....May 27
Jun. 10. Conduit, Dallas, Tex. ....May 27
Jun. 10. Pipe, Washington, D. C. ....May 27
Jun. 10. Irrig. work, Montpelier, Idaho ......May 27
Adv. May 27.
Jun. 12. Pipe, Whittier, Cal. ....May 13
Adv. Apr. 22 to May 20.
Jun. 12. Well, Whittier, Cal. ....May 13
Adv. May 13.
June 12. Pump, etc., Whittier, Cal............May 13
Adv. May 13.
Jun. 13. Laying pipe, etc., Cincinnati, O. (2 prop.). Adv. May 20, 27............May 20
Jun. 14. Well, Ft. Caswell, N. C. ....May 20
Adv. May 20, 27.
Jun. 15. Canal, etc., Minidoka, Idaho ....Apr. 22
Adv. Apr. 29 to May 27.
Jun. 15. Dam, etc., Casper, Wyo..............Apr. 29
Adv. Apr. 29 to May 20.
Jun. 15. Controlling works, etc., Tahoe, Cal....May 6
Adv. May 6 to 27.
Jun. 15. Purification wks., etc., Columbus, O..May 13
Adv. May 13 to 27.
Jun. 19. Purchase of engines, etc., Cleveland, O.May 20
Adv. May 20.
Jun. 22. Alma, Neb. Adv. May 27 ....May 27
Jun. 24. Reservoir, Guantanamo, Cuba.........May 20
Jun. 28. Irrig. work, Billings, Mont. ....May 6
Adv. May 6 to 27.
Jun. 28. Pump sta., etc., Huntley, Mont.......May 6
Adv. May 6 to 27.
Jun. —. Prescott, Wash. ....Apr. 1
Jun. —. Alma, Wash. ....Apr. 22
Jun. —. Pumps, etc., Richland, Ga. ....Apr. 22
Jun. —. Pipe, etc., Thibodaux, La. ....Apr. 22

SEWERAGE AND SEWAGE DISPOSAL.

May 30. Des Moines, Ia.......................May 27
May 31. Shiprock, N. M. ....May 13
May 31. Pine Bluff, Ark. ....May 13
Adv. May 13 to 27.
May 31. Columbus, O. ....May 20
May 31. Brooklyn, N. Y. ....May 20
May 31. Merrill, Wis. ....May 20
May 31. New York, N. Y. ....May 20
May 31. Buffalo, N. Y. ....May 20
May —. New Britain, Conn...................Apr. 8
June 1. Darlington, S. C. ....May 13
Adv. May 13, 20.
Jun. 1. Mansfield, O. ....May 20
Jun. 1. Youngstown, O. ....May 27
Jun. 1. Erie, Pa. ....May 27
Adv. May 27.
Jun. 1. Tell City, Ind. ....May 27
Jun. 1. Bismarck, N. D. ....May 27
Jun. 1. Tulsa, Ind. Ter. ....May 27
Jun. 1. Cincinnati, O. ....May 27
June 2. Tulalip, Wash. ....May 13
Jun. 2. Little Falls, N. Y. ....May 27
June 5. Webb City, Mo.......................May 13
Adv. May 13, 20.
Jun. 5. Plainfield, N. J. ....May 20
Adv. May 20, 27.
Jun. 5. Stevens Point, Wis. ....May 27
Jun. 5. Lakewood, O. ....May 27
Jun. 5. Meridian, Miss. ....May 27
Jun. 6. Rockford, Ill. Adv. May 20 ....May 20
Jun. 6. Washington, D. C. ....May 27
Jun. 6 Trenton, N. J. ....May 27
Jun. 6. Maryville, Mo. ....May 27
Jun. 7. Susquehanna, Pa. ....May 27
Jun. 9. Cincinnati, O. ....May 20
Jun. 9. Meridian, Miss. ....May 27
Jun. 10. Xenia, O. ....May 27
Adv. May 27.
Jun. 10. Washington, D. C. ....May 27
Jun. 12. Cambridge, O. ....May 27
Adv. May 27.
Jun. 13. Milton, Pa. ....May 27
Jun. 15. Cincinnati, O. ....May 27
Jun. 17. Oconto, Wis. ....May 20
Adv. May 20, 27.
Jun. 20. Waterbury, Conn. ....May 20
Adv. May 20.
Jun. 20. Chicago, Ill. Adv. May 27 ....Mayl 27
June —. Sacramento, Cal. ....May 13

BRIDGES.

May 31. Ft. Wayne, Ind. ....May 27
May 31. Moncton, B. C. ....May 27
Jun. 1. Lima, O. ....May 13

Erie, Pa.—Col. H. M. Adams, Corps Engrs., U. S. A., Buffalo, N. Y., writes that the following are the bids opened May 22 for extension of south pier and concrete superstructure on north pier at Erie: (*a*) Wm. P. Donnelly, Buffalo, N. Y.; (*b*) Continental Eng. & Contr. Co., Buffalo, N. Y.; (*c*) L. P. & J. A. Smith Co., Cleveland, O.; (*d*) Lake Erie Dredging Co., Buffalo, N. Y.; (*e*) Wm. H. Shelton, Dunkirk, N. Y. (recommended for acceptance); (*f*) A. F. Chapman & Co., Buffalo, N. Y.

	Extension of South Pier.								*Concrete Superstructure of North Pier.*												
	Dredging for foundation, 1,900 cu. yds.	Foundation stone, 3,000 cu. yds.	Rip-rap stone, 150 cu. yds.	Timber cribs complete, 500 lin. ft.	Concrete blocks, 575 cu. yds.	Filling stone in superstructure, 1,000 cu. yds.	Mass concrete, 688 cu. yds.	Manhole covers, 13.	Removing old superstructure, 752 lin. ft.	New hemlock timber, above 4 ft. level, 15 M. ft.	New hemlock timber, below 4 ft. level, 1 M. ft.	New white oak piles, 20 ea.	New stone filling in concrete superstructure, 100 cu. yds.	Concrete blocks (set), 612 cu. yd.	Concrete blocks molded in place, 222 cu. yd.	Mass concrete, 1,118 cu. yd.	Manhole covers, 17 ea.	Mooring posts, 4 ea.	White oak fenders, 21 ea.	Total.
a	$0.40	$2.10	$3.00	$62.00	$13.00	$1.85	$11.00	$4.75	$15.00	$100.00	$100.00	$12.00	$1.90	$13.00	$12.00	$11.00	$4.75	$47.00	$11.00	$92,192
b	.49	2.10	5.00	66.00	12.00	2.05	10.25	5.00	9.00	100.00	200.00	25.00	2.00	11.50	10.00	9.00	5.00	20.00	15.00	86,016
c	.60	2.50	4.00	59.00	13.00	2.45	11.50	5.00	8.50	95.00	225.00	25.00	2.45	13.00	11.50	11.50	5.00	15.00	12.00	89,192
d	.35	2.20	4.50	68.00	12.75	2.20	10.50	5.00	10.00	100.00	250.00	28.00	2.20	12.00	11.00	9.50	5.00	35.00	18.00	89,820
e	.40	2.00	3.00	36.00	10.95	2.00	8.95	4.50	7.50	65.00	100.00	7.00	2.50	10.95	9.25	8.95	4.50	22.50	4.65	65,852
f	.55	2.25	5.20	65.50	12.50	2.20	10.00	6.00	9.50	80.00	150.00	26.00	2.20	12.50	10.50	10.00	6.00	45.00	10.00	88,557

**Items marked thus give the names of parties awarded contracts.*

Jun. 1.	Mallory, Minn.	May 13
Jun. 1.	Waterford, Pa.	May 20
Jun. 1.	Crookston, Minn.	May 20
Jun. 1.	Indianapolis, Ind.	May 20
Jun. 1.	Jersey City, N. J.	May 27
Jun. 1.	Dallas, Tex.	May 27
Jun. 1.	Mt. Holly, N. J.	May 27
Jun. 1.	Knoxville, Tenn.	May 27
Jun. 1.	Mansfield, O.	May 27
Jun. 1.	Crysler, Ont.	May 27
Jun. 3.	Mifflintown, Pa.	May 20
Jun. 5.	Lancaster, Pa.	May 20
Jun. 5.	Versailles, Ind.	May 20
Jun. 5.	Fulton, Miss.	May 20
Jun. 5.	Wilkesbarre, Pa.	May 20
Jun. 5.	Garnett, Kan.	May 27
Jun. 5.	Bloomfield, Ind.	May 27
Jun. 5.	Pontiac, Mich. Adv. May 27.	May 27
Jun. 6.	Dayton, O. Adv. May 13 to 27.	May 13
Jun. 6.	Marion, O.	May 20
Jun. 6.	Perth, Ont.	May 20
Jun. 6.	Plymouth, Ind.	May 27
Jun. 6.	Mitchell, Ont.	May 27
Jun. 7.	Lafayette, Ind.	May 20
Jun. 7.	Iola, Kan.	May 27
Jun. 8.	Towson, Md.	May 27
Jun. 10.	Rockville, Ind.	May 20
Jun. 10.	Cleveland, O.	May 27
Jun. 13.	Miniota, Man.	May 27
Jun. 13.	Kingston, Ga.	May 27
Jun. 15.	Ainsworth, Neb.	May 20
Jun. 17.	Chesley, Ont.	May 20
Jun. 20.	Cadillac, Mich. Adv. May 13 to 27.	May 13
Jul. 5.	Tillamook, Ore.	May 27
Jul. 6.	Redding, Cal.	May 27

PAVING AND ROADMAKING.

May 30.	Shelbyville, Ind.	May 27
May 30.	Ellicott City, Ind.	May 27
May 30.	Cleveland, O.	May 20
May 31.	Salem, O.	May 27
May 31.	Lucknow, Ont.	May 27
May 31.	Washington, D. C.	May 13
May 31.	San Francisco, Cal.	May 13
May 31.	Baltimore, Md.	May 27
May 31.	Somers, Conn.	May 27
Jun. 1.	Hutchinson, Kan.	May 27
Jun. 1.	Owensboro, Ky.	Apr. 22
Jun. 1.	Findlay, O.	May 13
Jun. 1.	Tacoma, Wash.	May 13
Jun. 1.	Mansfield, O.	May 20
Jun. 1.	Oxford, N. Y. Adv. May 20.	May 20
Jun. 1.	Elmira, N. Y. Adv. May 20.	May 20
Jun. 1.	Traverse City, Mich. Adv. May 20, 27.	May 20
Jun. 1.	Brooklyn, N. Y.	May 20
Jun. 1.	New York, N. Y.	May 27
Jun. 1.	Jersey City, N. J.	May 27
Jun. 1.	Ft. Caswell, N. C.	May 27
Jun. 1.	Cumberland, Md.	May 27
Jun. 1.	Lindsay, Ont.	May 27
Jun. 1.	Danville, Ky.	May 27
Jun. 1.	Columbus, O.	May 27
Jun. 2.	**Cincinnati, O.**	**May 6**
Jun. 2.	Rockville, Md.	May 27
Jun. 3.	Ann Arbor, Mich. Adv. May 27.	May 27
Jun. 3.	Freeport, Ill. Adv. May 27.	May 27
Jun. 3.	Muskegon, Mich.	May 27
Jun. 5.	Cincinnati, O.	May 13
Jun. 5.	Emporia, Kan.	May 27
Jun. 5.	Rockville, Ind.	May 20
Jun. 5.	Antigo, Wis.	May 20
Jun. 5.	Bedford, Ind.	May 20
Jun. 5.	Grenada, Miss.	May 20
Jun. 5.	Bloomfield, Ind.	May 27
Jun. 5.	St. Paul, Minn.	May 27
Jun. 5.	Gloversville, N. Y.	May 27
Jun. 5.	Rockville, Ind.	May 27
Jun. 5.	Winamac, Ind.	May 27
Jun. 5.	Kansas City, Kan.	May 27
Jun. 6.	Waterbury, Conn.	May 13
Jun. 6.	Indianapolis, Ind.	May 13
Jun. 6.	Amsterdam, N. Y.	May 13
Jun. 6.	Washington, D. C.	May 27
Jun. 6.	Brownstown, Ind.	May 27
Jun. 7.	Flemington, N. J. Adv. May 13 to 27.	May 13
Jun. 7.	East Cleveland, O.	May 20
Jun. 7.	Providence, R. I.	May 27
Jun. 8.	Cincinnati, O.	May 20
Jun. 8.	Towson, Md.	May 27
Jun. 10.	Wyoming, O.	May 20
Jun. 10.	Cleveland, O.	May 27
Jun. 10.	Washington, D. C.	May 27
Jun. 12.	Cincinnati, O.	May 27
Jun. 12.	Houghton, Mich.	May 27
Jun. 14.	Freehold, N. J.	May 27
Jun. 14.	Ft. Strong, Mass.	May 27
Jun. 14.	Brooklyn, N. Y.	May 27
Jun. 15.	Cincinnati, O.	May 27
Jun. 15.	Corning, N. Y.	May 27
Jun. 16.	Cincinnati, O. Adv. May 27.	May 20
Jun. 17.	La Crosse, Wis.	May 27
Jun. 19.	New Orleans, La. Adv. May 13 to 20.	May 13
Jun. 19.	Morristown, N. J. Adv. May 27.	May 27
Jun. —.	Council Bluffs, Ia.	May 20
Aug. 1.	Belvidere, Ill.	May 20
———.	Grand Junction, Colo.	May 27

POWER, GAS AND ELECTRICITY.

May 31.	**Washington, D. C.** Adv. Apr. 20 to May 6.	**Apr. 29**
May 31.	Washington, D. C.	May 13
May 31.	Hawley, Pa.	May 27
Jun. 1.	**Spartanburg, S. C.**	**Apr. 29**
Jun. 1.	Augusta, Ky.	May 27
Jun. 2.	Ft. Totten, N. Y. Adv. May 27.	May 27
Jun 3.	**Cape Charles, Va.**	**Apr. 8**
Jun. 5.	Visalia, Cal.	May 20
Jun. 5.	New York, N. Y.	May 27
Jun. 5.	Jamaica, L. I., N. Y.	May 27
Jun. 6.	**Sebastapol, Cal.**	**Apr. 22**
Jun. 6.	Shelbyville, Tenn.	May 13
Jun. 6.	N. Tonawanda, N. Y.	May 20
Jun. 6.	Washington, D. C.	May 27
Jun. 8.	**Newport, Ky.**	**Apr. 29**
Jun. 8.	Wilmington, N. C. Adv. May 20, 27.	May 20
Jun. 10.	Norfolk, Va.	May 20
Jun. 10.	Washington, D. C. Adv. May 20, 27.	May 20
Jun. 12.	Winnipeg, Man. Adv. May 20, 27.	May 20
Jun. 15.	Selingsgrove, Pa.	May 27
Jun. 16.	Grand Haven, Mich. Adv. May 27.	May 27
Jun. 22.	Alma, Neb. Adv. May 27.	May 27
Jun. —.	Reading, O.	May 13

BUILDINGS.

May 30.	**Pub. Bldg., Cleveland, O.**	**May 20**
May 30.	School, Toronto, Ont.	May 27
May 31.	**P. O. Bldg., Allentown, Pa.**	**Apr. 29**
May 31.	**Boat house, etc., Philadelphia, Pa.**	**May 6**
May 31.	Courthouse, Baltimore, Md.	May 13
May 31.	School, Shiprock, N. M.	May 13
May 31.	Court house, Darlington, Wis.	May 13
May 31.	**Pub. Bldg., Oklahoma, Okla. Ter.**	**May 20**
May 31.	**Post Bldg., Addition Governor's Island,** N. Y. Adv. May 20, 27	May 20
May 31.	**Post Bldg. work, Ft. Mott, N. J.** Adv. May 20, 27.	May 20
May 31.	**Library stacks, Washington, D. C.** Adv. May 20, 27.	May 20
May 31.	New York, N. Y.	May 20
May 31.	Pub. Bldg., New York, N. Y.	May 20
May 31.	School, Lima, N. Y.	May 20
May 31.	Pub. Bldg., St. Boniface, Man.	May 20
May 31.	Court House, Savannah, Tenn.	May 27
May 31.	Sharpsburg, Pa.	May 27
Jun. 1.	P. O. Bldg., Little Falls, N. Y. Adv. May 6 to 27.	Apr. 29
Jun. 1.	**Bank, Knoxville, Tenn.**	**Bay 6**
Jun. 1.	School, Pine Ridge, S. D.	May 13
Jun. 1.	School, Huntington, W. Va.	May 13
Jun. 1.	Church, South Shore, S. D.	May 20
Jun. 1.	Pub. Bldgs., Lincoln, Neb.	May 20
Jun. 1.	Pub. Bldg., Chicago, Ill.	May 20
Jun. 1.	Library, Watertown, S. D.	May 20
Jun. 1.	Hotel, Hot Springs, Ark.	May 20
Jun. 1.	Bus. bldg., Corsicana, Tex.	May 27
Jun. 1.	School, Holton, Kan.	May 27
Jun. 1.	Fire station, Montreal, Que.	May 27
Jun. 1.	Library, Watertown, S. D.	May 27
Jun. 2.	Bus. building, Washington, Ind.	May 13
Jun. 2.	School, Tulalip, Wash.	May 13
Jun. 2.	School, Girard, O.	May 20
Jun. 2.	Hospital, Nevada, Mo.	May 20
Jun. 2.	Church, St. Paul, Minn.	May 20
Jun. 2.	Schools, Ft. Worth, Tex.	May 27
Jun. 2.	Hosp. New York, N. Y.	May 27
Jun. 3.	School, Durham, N. H.	May 20
Jun. 3.	Pub. Bldg., Washington, D. C.	May 20
Jun. 3.	Bus. Bldg., Indianapolis, Ind.	May 27
Jun. 3.	Pub. bldg., Washington, D. C.	May 27
Jun. 5.	Capitol, Frankfort, Ky.	Apr. 22
Jun. 5.	**P. O. Bldg., Crawfordsville, Ind.**	**Apr. 29**
Jun. 5.	School, Watervliet, N. Y.	May 13
Jun. 5.	School, Groveport, O.	May 13
Jun. 5.	School, Lorain, O.	May 20
Jun. 5.	School, East St. Louis, Ill.	May 20
Jun. 5.	Post Bldg., Ft. Miley, Cal.	May 20
Jun. 5.	Pub. Bldg., Buffalo, Wyo.	May 20
Jun. 5.	Schools, New York, N. Y.	May 27
Jun. 5.	Pub. Bldgs., Barron, Wis.	May 27
Jun. 5.	School addition, East St. Louis, Ill.	May 27
Jun. 5.	School, Plymouth, O.	May 27
Jun. 5.	School, Toledo, O.	May 27
Jun. 5.	Vent, etc., school, Buckland, O.	May 27
Jun. 5.	Jail, Belmont, Nev.	May 27
Jun. 6.	**P. O. Bldg., Rockhill, S. C.**	**Apr. 29**
Jun. 6.	**School, Wellsville, O.**	**May 20**
Jun. 6.	School, Orange, N. J.	May 27
Jun. 6.	School, Galena, Ill.	May 27
Jun. 7.	**P. O. bldg., Reno, Nev.**	**May 6**
Jun. 7.	Pub. buildings, Honolulu, H. I.	May 13
Jun. 7.	**Magazine, etc., Ft. Mifflin, Pa.**	**May 20**
Jun. 7.	Hospital, Brooklyn, N. Y.	May 27
Jun. 7.	Hospital, Jackson, Miss.	May 27
Jun. 7.	Engine house, Kansas City, Mo.	May 27
Jun. 8.	**P.-O. bldg., Amesbury, Mass.** Adv. May 20, 27.	**May 6**
Jun. 8.	School, Hilliards, O.	May 20
Jun. 8.	**Post. Bldgs., Ft. Totten, N. Y.** Adv. May 20, 27.	**May 20**
Jun. 8.	**Library, Union, N. J.**	**May 20**
Jun. 8.	Pub. Bldg., Ft. Riley, Kan.	May 27
Jun. 8.	School, Riverside, Cal.	May 27
Jun. 8.	Pub. bldg., Marietta, O.	May 27
Jun. 9.	Pub. Bldgs., Washington, D. C.	May 27
Jun. 9.	Pub. bldg., Ft. Scott, Kan.	May 27
Jun. 10.	**Schools, Alaska**	**May 6**
Jun. 10.	**Court house, Plaquemine, La.** Adv. May 6 to 27.	**May 6**
Jun. 10.	Bus. Bldg., Baton Rouge, La.	May 27
Jun. 10.	School, St. Wendells, Ind.	May 27
Jun. 10.	School, Piqua, O.	May 27
Jun. 12.	Capitol plans, Boise, Idaho	Apr. 22
Jun. 12.	**School, Cleveland, O.**	**May 20**
Jun. 12.	School, Baton Rouge, La.	May 27
Jun. 12.	Jail, etc., Newburgh, N. Y.	May 27
Jun. 12.	Schools, New York, N. Y.	May 27
Jun. 14.	Pub. Bldgs., Lawrence, Ind. Adv. May 20.	May 20
Jun. 15.	**Court House plans, New Orleans, La.** **Adv. Apr. 29.**	Feb. 25
Jun. 15.	Synagogue plans, Houston, Tex.	Apr. 15
Jun. 15.	**Court House plans, New Orleans, La.**	**Apr. 22**
Jun. 15.	**Pub. bldg., Honolulu, H. I.**	**Apr. 29**
Jun. 15.	**Window screens, etc., at Post, Key** West Barracks, Fla. Adv. May 20, 27.	May 20
Jun. 15.	**Boat House, Key West Barracks, Fla.** Adv. May 20, 27.	May 20
Jun. 15.	Post bldg., Oswego, N. Y. Adv. May 27.	May 27
Jun. 15.	Post bldg., Ft. Wright, Wash.	May 27
Jun. 15.	Hospital, Patton, Cal.	May 27
Jun. 15.	School, Cleveland, O.	May 27
June. 16.	Pub. Bldg., Ft. Hancock, N. J. (2 prop) Adv. May 20, 27	May 20
Jun. 17.	School, Toledo, O.	May 27
Jun. 19.	P. O. Bldg., Atlantic, Ia.	May 20
Jun. 19.	**School, Grand Rapids, Mich.**	**May 20**
Jun. 19.	Light House, Baltimore, Md. Adv. May 27.	May 27
Jun. 19.	School, St. Johns, O.	May 27
Jun. 20.	P. O. Bldg., Colorado Springs, Colo. Adv. May 13, 20	May 20
Jun. 20.	School, Port Arthur, Tex.	May 27
Jun. 21.	P. O. Bldg., Winston, N. C.	May 20
Jun. 23.	P. O. bldg., Vancouver, B. C.	May 27
Jun. 26.	P. O. Bldg., Niagara Falls, N. Y.	May 27
Jun. 28.	P. O. Bldg., Westchester, Pa.	May 27
Jun. —.	School plans, Stillwater, Okla. Ter.	May 20
Jul 1.	Pub. Bldg., Washington, D. C.	May 27
Jul. 1.	Pub. Bldg., Baltimore, Md.	May 20
Jul. 5.	Court House plans, Montgomery, Ala.	May 27
Jul. 30.	Court House improv., Leesville, La.	May 13
Aug. 1.	**Y. M. C. A. Bldg., Spokane, Wash.**	**Apr. 29**
———.	School, Carlisle, Pa.	May 27

STREET CLEANING AND GARBAGE DISPOSAL.

Jun. 1.	Street cleaning, Philadelphia, Pa.	May 20

MISCELLANEOUS.

May 30.	**Steel shed, New Orleans, La.** Adv. May 13 to 20.	May 13
May 30.	Improv. canal, Columbus, O.	**May 20**
May 30.	Levee, etc., New Orleans, La. Adv. May 13 to 27.	May 13
May 31.	**Docks, etc., Cincinnati, O.**	**May 6**
May 31.	**Dredging, Mobile, Ala.** Adv. May 6 to 27.	**May 6**
May 31.	**Supplies, Washington, D. C.**	**May 13**
May 31.	**Dump carts, etc., Panama**	**May 13**
May 31.	**Pier, Peel Head Bay, Que.**	**May 13**
May 31.	Levee work. Vicksburg, Miss. Adv. May 13 to 27.	May 13
May 31.	**Dredge, Galveston, Tex.** Adv. May 13 to 27.	**May 6**
Jun. 1.	Telephone system, Glendive, Mont. Adv. Apr. 29 to May 20.	Apr. 29
Jun. 1.	**Conduit, Boston, Mass.** Adv. May 20, 27.	**May 20**
Jun. 1.	**Cement, Mansfield, O.** Adv. May 20.	**May 20**
Jun. 1.	Htg. School, Bozeman, Mont.	May 27
Jun. 1.	Park improv., New York, N. Y.	May 27
Jun. 2.	**Channel, Grand Rapids, Mich.** Adv. May 6 to 27.	**May 6**
Jun. 2.	Cement, New York	May 27
Jun. 3.	**Dredging, Norfolk, Va.**	**May 20**
Jun. 5.	Breakwater, Port Stanley, Ont.	May 13
Jun. 5.	**Timber, Nashville, Tenn.**	**May 6**
Jun. 5.	Dredging, Cleveland, O.	May 13
Jun. 5.	**Pier work, Port Wing, Wis.** Adv. May 13 to 27.	**May 13**
Jun. 5.	Dredging, Wilmington, Del. Adv. May 13 to 27.	May 13
Jun. 5.	**Jetties, Ft. Screven, Ga.** Adv. May 20, 27.	**May 20**
Jun. 5.	**Wharf, etc., Ft. Wood, N. Y. H., N. Y.** Adv. May 20, 27.	**May 20**
Jun. 5.	Conveyor, New York, N. Y.	May 27
Jun. 6.	Channel excav., Ogdensburg, N. Y. Adv. May 13 to 27.	May 13
Jun. 6.	Supplies, Washington, D. C.	May 27
Jun. 6.	Supplies, Washington, D. C.	May 13
Jun. 7.	Rostrum, Culpeper, Va. Adv. May 13 to 27.	May 13
Jun. 8.	**Dikes, Augusta, Ga.** Adv. May 6 to 27.	**May 6**
Jun. 8.	Jetty work, Cleveland, O. Adv. May 13, 20.	May 13
Jun. 8.	**Supplies, Wilmington, N. C.**	**May 20**
Jun. 8.	Canal, Onawa, Iowa Adv. May 20, 27.	May 20
Jun. 9.	Pump Mchry., etc. in P. O. Bldg. Newport News, Va. Adv. May 20, 27.	May 20
Jun. 9.	Wharf, New Carlisle, Que.	May 27
Jun. 10.	Iron wk. for lock, Little Rock, Ark. Adv. May 13 to 27.	May 13
Jun. 10.	**Pier, Detroit, Mich.** Adv. May 13 to 27.	**May 13**
Jun. 10.	Dredging, Wilmington, Del.	May 20
Jun. 10.	Cement for lock, Little Rock, Ark. Adv. May 13 to 27.	May 13
Jun 12.	Ditch work, Geneseo, Ill. Adv. May 13, 20.	May 13
Jun. 12.	**Dredging, Lynn, Mass.** Adv. May 13 to 27.	**May 13**
Jun. 12.	Terrace wall, Holyoke, Mass. Adv. May 27.	May 27
Jun. 13.	Pier, Gallipolis, O.	May 20
Jun. 13.	**Pier, Maysville, Ky.**	**May 20**
Jun. 13.	Dam, Iowa City, Ia. Adv. May 27.	May 27
Jun. 14.	**Bldg. Material, etc., West Point, N. Y.** Adv. May 20, 27.	May 20
Jun. 14.	**Rubblestone, Boston, Mass.** Adv. May 20, 27.	**May 20**
Jun. 14.	Tower, Philadelphia, Pa.	May 20
Jun. 15.	**Pole and telephone line, Minidoka,** Idaho. Adv. Apr. 22 to May 27.	Apr. 22
Jun. 15.	**Wharf, etc., Honolulu**	**Apr. 29**
Jun. 15.	Trestles, etc., Louisville, Ky. Adv. May 20, 27.	May 20
Jun. 15.	**Excav, etc., Panama** Adv. May 20, 27.	**May 20**
Jun. 15.	Dredging, Mobile, Ala. Adv. May 20, 27.	May 20
Jun. 15.	Remov. wreck, Jacksonville, Fla. Adv. May 20, 27.	May 20
Jun. 15.	Jetty work, Sabine Pass, Tex. Adv. May 27.	May 27
Jun. 19.	Dredging, Norfolk, Va. Adv. May 27.	May 27
Jun. 19.	Dredging, Wilmington, Del. Adv. May 20, 27.	May 20
Jun. 19.	Supplies, Rock Island, Ill.	May 27
Jun. 19.	Breakwater, Cleveland, O.	May 27
Jun. 20.	**Searchlight outfit, Washington, D. C.** Adv. May 13 to 27.	**May 20**
Jun. 20.	Dredging, Wilmington, Del. Adv. May 27.	May 27
Jun. 20.	Dredging, Baltimore, Md. Adv. May 27.	May 27
Jun. 20.	Dredging, Detroit, Mich. Adv. May 27.	May 27
Jun. 20.	Elevator, Washington, D. C.	May 27
Jun. 20.	Levee, Walnut Hill, Ark.	May 27
Jun. 21.	Light house supplies, Tompkinsville, S. I., N. Y. Adv. May 27	May 27
Jun. 21.	Dredging, Baltimore, Md. Adv. May 27.	May 27
Jun. 21.	Levee work, Hopefield, Ark. Adv. May 13 to 27.	May 27
Jun. 21.	Dredging, Wilmington, Del.	May 27
Jun. 22.	Dredging, Detroit, Mich. Adv. May 27.	May 27
Jun. 22.	Sea Wall, Governor's Island, N. Y. H. Adv. May 27.	May 27
Jun. 24.	El. Ry. franchise, Hollister, Cal.	May 20
Jun. 26.	Telephone system, Belle Fourche, S. D. Adv. May 27.	May 27
Jun. 27.	Dredging, Boston, Mass. Adv. May 27.	May 27
Jun. —.	**Dam, Iowa City, Ia.**	**Apr. 22**
Jun. —.	Subway, Memphis, Tenn.	May 13
Jul 1.	**Municipal St. Ry. system, Chicago, Ill.** **Adv. Apr. 15 to May 6.**	**Apr. 15**
Aug. 26.	Coal plant, Olongapo, P. I.	May 6
Sep. 1.	**Steel and iron, Sydney, N. S. Wales** **Adv. Apr. 8, 22, May 6, 20.**	**Apr. 22**
Apr. 2, '06.	Harbor Work, Valparaiso, Chili Adv. Apr. 29 to May 27.	Apr. 29